DESIGN, CONSTRUCTION, OPERATION OF METAL-WORKING AND ALLIED EQUIPMENT

MACHINERY

AUGUST, 1943

PRINCIPAL CONTENTS OF THIS NUMBER

The leading article in September MACHINERY will describe the making of shells for the largest mobile howitzer in the world. Detailed descriptions of machines and methods will be included. Another article representing unusual practice will deal with methods of "stretching" airplane parts in a large aircraft plant. A series of articles on the design of stampings to facilitate production will also begin in this number, and further information on how to get the most out of carbide tools will be given.

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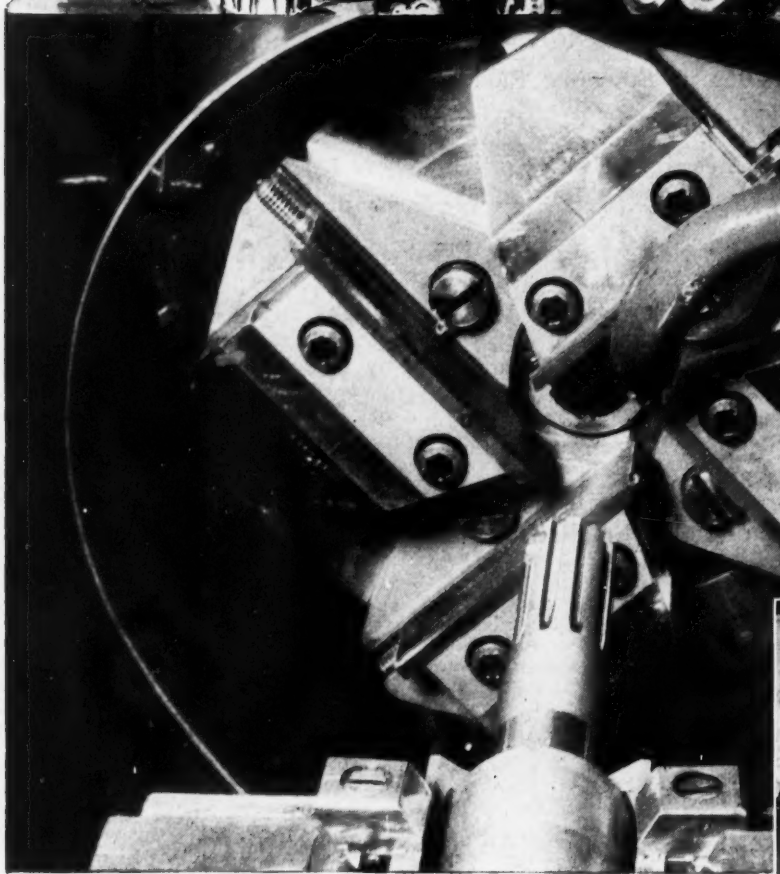

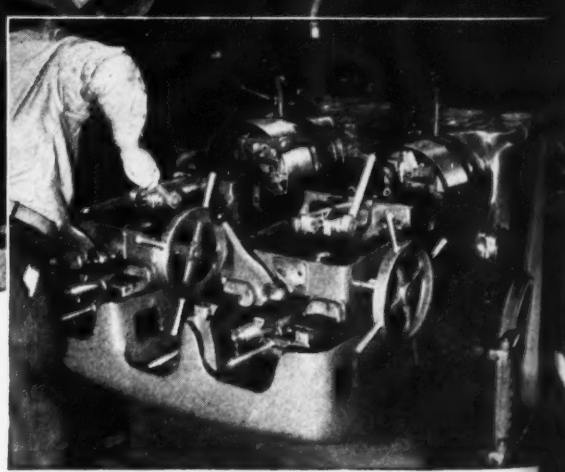

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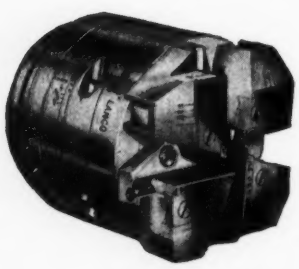

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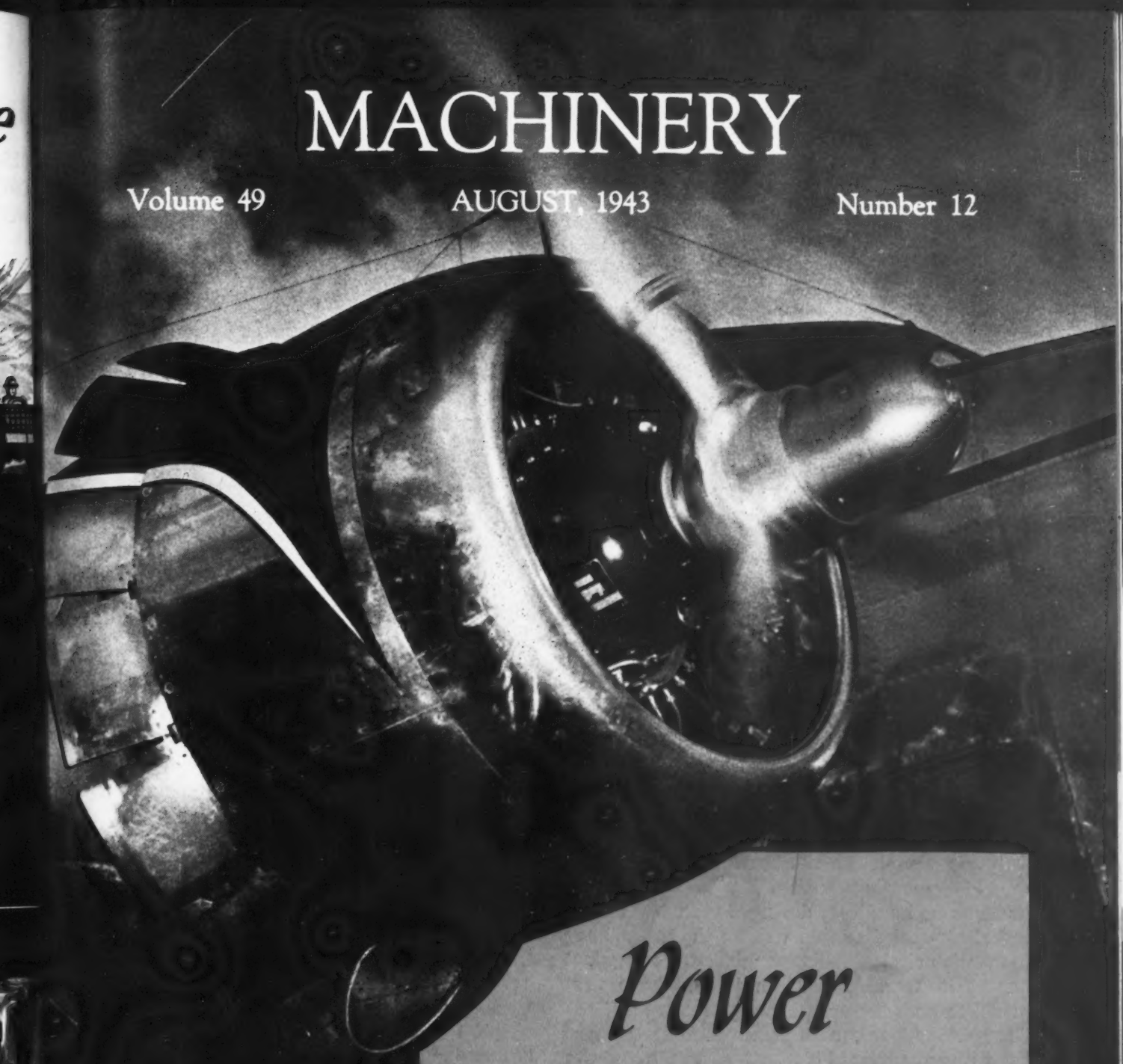


Power

FOR THE ALLIED AIR ARMADAS

The output of the American aircraft industry this year will reach the colossal total of twenty billions of dollars—seven times the highest output of the automobile industry in any peacetime year! In dollar value of output, the aircraft industry is now the most important in this country. Because of this fact, MACHINERY'S sixth annual Aircraft Production number is being published in two sections. July MACHINERY featured methods developed during the last year in the factories that build the planes themselves. This number describes new operations in producing "power plants" capable of developing hundreds of millions of horsepower for propelling the Allied air armadas to certain victory.

Allison
FOR POWERING

THE Allison liquid-cooled aircraft engine is completely the product of American engineering brains. It was developed, under some handicap, during a period when the radial air-cooled engine was on the ascendancy in aviation circles. Allison engineers won against almost insuperable odds in building the first model to pass the exacting requirements of the Army Air Corps, and persisted only because they were convinced that there was a definite place in aviation for engines of this type.

Their judgment has been vindicated by the fact that today liquid-cooled engines are widely used as the power plants for many fast fighter planes. The horizontal design of this type of engine facilitates streamlining the plane fuselage to attain minimum wind resistance, which is, of course, one of the most important factors in designing fighting planes. Allison engines drive such famous American fighters as Lockheed Lightnings, Curtiss Warhawks, Bell Airacobras, and North American Mustangs.

Another Allison achievement has been the simplification of this engine, in the interests of mass production, to the point where it comprises only 750 different parts, as against 2300 different parts in the most widely known liquid-cooled engine of European design. This simplification greatly reduced the number of manufacturing operations and aids engine maintenance in the field. All together, there are approximately 7000 pieces in an Allison engine, but a considerable number are duplicates.

In the summer of 1939, the concern started the construction of a large windowless air-conditioned factory for the mass production of Allison engines. By the spring of 1940, this—the first blackout plant of the aircraft industry—was in full operation. It was featured in an article published in July, 1940, MACHINERY, which described a number of outstanding operations performed in that plant. Since that time, the concern has built several more plants, also in the environs of Indianapolis, and has just completed the largest of them all. In line with the construction of new plants, advanced machining methods have been devised.

Automatic machines have been developed to eliminate the many hours of hand-lapping previously necessary on cylinder-head assemblies and

Engines
FAST FIGHTER PLANES

Unusual Shop Methods Employed by the Allison Division of General Motors Corporation in Manufacturing the Only American-Designed Liquid-Cooled Aircraft Engine

By CHARLES O HERB

cylinder-head covers. The machine designed for lapping the cylinder-head covers is shown in Fig. 1. For this operation, the covers are mounted on fixtures that are interchangeable on the machine, so that one cover can be loaded on a fixture while another is being lapped. The fixtures are clamped, one at a time, to the bottom of a slide that reciprocates on a beam extending lengthwise of the machine. This beam is mounted on a carriage which rolls back and forth across the machine several times during an operation.

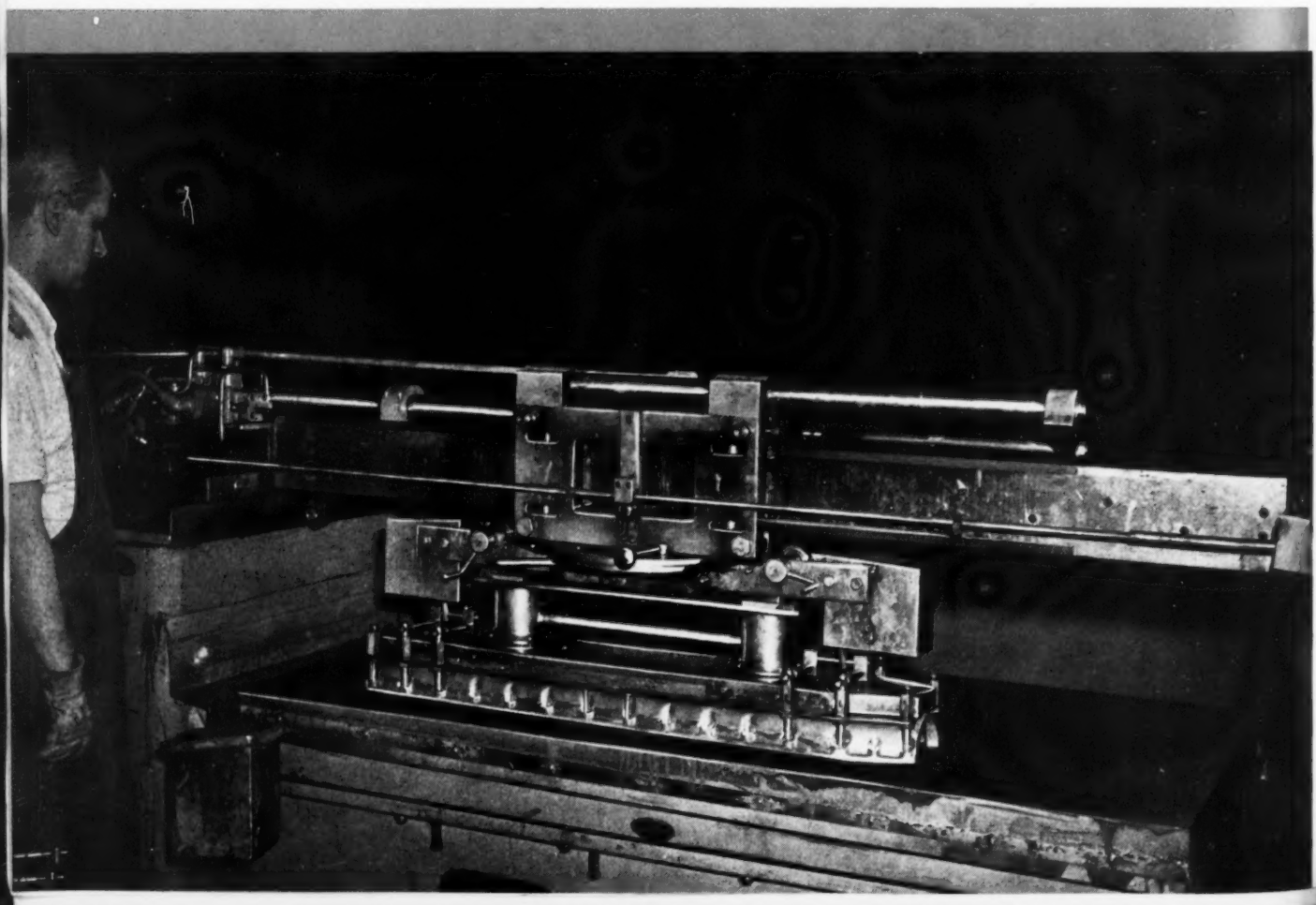
The two machine movements, both of which are derived from hydraulic cylinders, cause the cylinder-head cover to be reciprocated in a continuously changing path on a large smooth-topped lapping plate. This plate is kept supplied with a generous amount of lapping compound. The length of stroke is approximately 3 feet. At the end of about three minutes, the lapped surface of the cylinder-head covers has attained a high degree of flatness and smoothness.

One of the machines designed for lapping the top of the cylinder-head assemblies is illustrated in Fig. 3. This machine is based on the same principles as the one just described, but was a forerunner of the cylinder-head cover lapping machine, and for this reason, the lengthwise and horizontal movements of the work on top of the lapping plate are derived mechanically through sprocket and chain drives instead of being actuated by hydraulic cylinders and pistons.

The cylinder-head assembly is driven by means of two Bakelite plugs attached to the overhead slide, which are fitted into the cylinders of the assembly when a section of the slide is lowered after an assembly has been placed on the lapping table. In an operation, the work is carried twice back and forth across the table, being, of course, reciprocated lengthwise at the same time. This operation takes between two and three minutes. The lapping table has serrations running crosswise and lengthwise.

The cylinder-head assemblies reach this lapping machine on a roller conveyor, with the top side up, and must be turned over for the operation. To take care of this, a turn-over section is built into the conveyor in front of the lapping machine. This section is elevated after an assembly has been pushed on it, and is then turned 180 degrees. A hoist is employed to swing the assembly into place on the lapping table.

"Mold-turning" on Cleveland Rigidturners is employed for machining a number of parts hav-



ing straight, tapered, or formed sections. In this turning method, a segment-shaped form cutter rolls along the work-piece as the latter is revolved and fed vertically past the cutter. A cutting edge is ground the full length of the cutter along its contoured edge. This cutting edge is always in a vertical plane at the point where it is tangential with the work. The cutter generates the desired shape on the work. It makes only a partial revolution to a complete pass of the work-piece.

In Fig. 2 one of these machines is shown set up for under-cutting a gear-shaft for a length of about 3 1/2 inches, as seen on the left-hand example that rests on the work-slide. The example at the right shows a gear-shaft before the operation has been performed. Stock to a depth of 1/8 inch per side is removed by the form cutter. The shoulder at the top end of the cut has a fillet of 1/16 inch radius, whereas a 3/8-inch fillet blends the under-cut portion into the larger diameter at the gear end of the shaft. The cutter and the shaft in place on the machine are seen in the starting position. At the end of the cut, the cutter will have swung upward through about 90 degrees and the work will have been fed upward along the cutter. The vertical cutting edge is set 0.013 inch off the vertical center of the work-piece.

This happens to be a straight turning job, whereas most operations performed on machines of this type consist of turning to an irregular outline. On coolant-pump covers, for example, there are two bosses which are turned straight for the greater portion of their length and then to a semi-spherical outline. The Rigidturners machine these bosses readily to their irregular contour.

A cam-plate mounted on one side of the knee of the Rigidturners travels with the work. This cam actuates a roller, which produces a swiveling movement of the cutter through a rack drive. With this arrangement, the movement of the tool can be slowed down or speeded up in accordance with the amount of stock being removed at different points along the work. Heavy cuts can be taken on work that must be machined to close dimensional accuracy, because the cut is distributed over several inches of tool contour. This enables precise work to be finished in one cut and greatly prolongs tool life. The cutter and cam must be changed for each job.

The machining of an irregular contour on the inside of the coolant-pump cover is accomplished by a special tool and cam on the Warner & Swasey turret lathe shown in Fig. 4. The operation consists of profiling clearance for the coolant pump. The cam is bolted to the turret face that is seen in line with the headstock in the illustration. On the square turret there is a special tool-bar provided with a spring that holds a carbide wear strip on the back end of the bar against the cam when the turret is brought up into the operating position. The opposite end of the tool-bar is equipped with a single-point carbide-tipped cutter.

With the cutter in contact with the work and

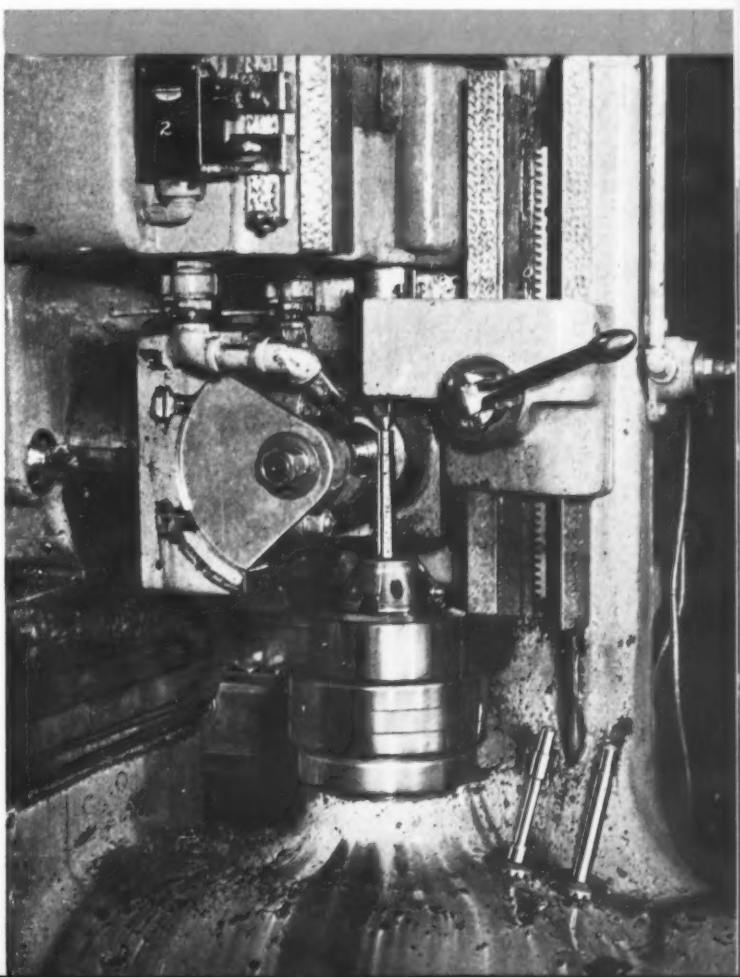


Fig. 1. (Left) Automatic Lapping Machine Designed for Obtaining Highly Accurate Joint Surfaces on Cylinder-head Covers

Fig. 2. (Right) Employing a Segment-shaped Form Cutter for Under-cutting Gear-shafts by the "Mold-turning" Process

Fig. 3. (Left) Automatic Lapping Machine that Produces a High Degree of Smoothness on the Top of Cylinder-head Assemblies

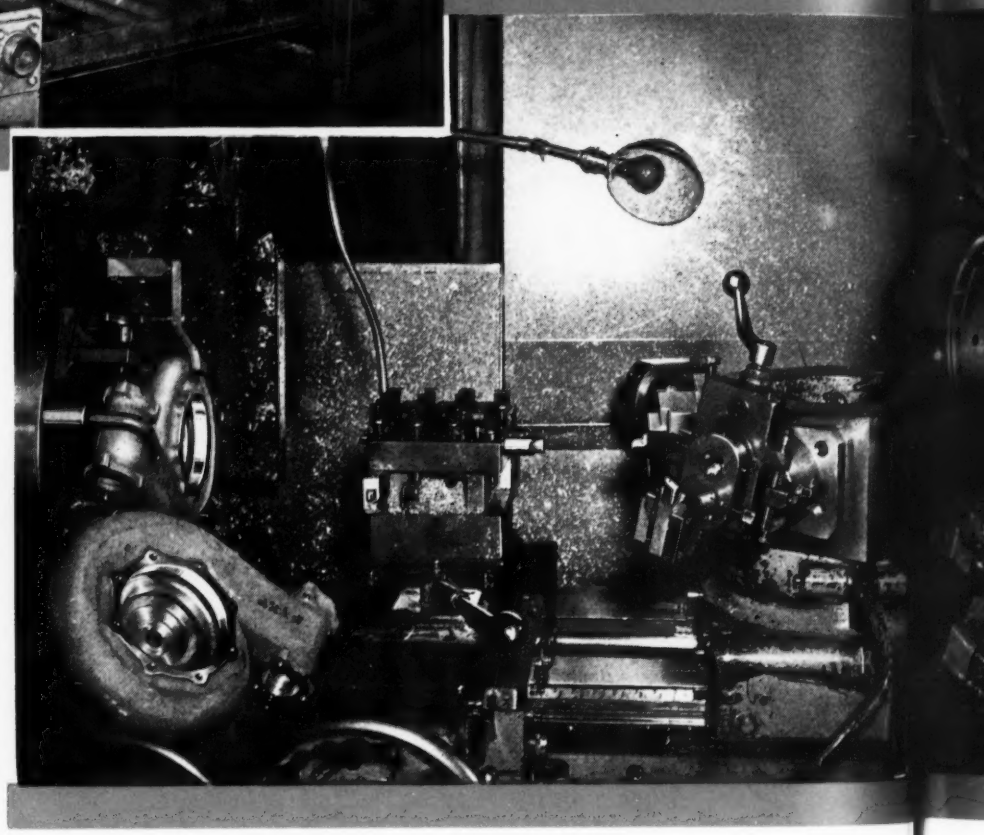


Fig. 4. (Right) Operation in which a Cam on the Hexagonal Turret is Used in Conjunction with a Tool on Square Turret for Taking an Internal Profiling Cut

the cam on the turret located against the back end of the tool-bar, the cutter is fed crosswise by means of the cross-slide for machining the irregular contour inside the coolant-pump cover. The desired profile is cut as the back end of the tool-bar moves along the changing profile of the cam. The cut on the work is first taken straight across, then at a radius to form a fillet, next to a taper, and finally straight across again. A rough profiling cut is taken by a built-up form cutter on one of the turret faces prior to the finish profiling operation just described. In addition to these profiling cuts, the pump cover is drilled, bored, faced, recessed, etc., in the same turret lathe, being machined to the stage indicated by the example seen lying on the front of the bed. The coolant-pump cover is a magnesium casting.

Nine holes in the accessory housing are bored simultaneously by the W. F. & John Barnes seven-head machine shown in Fig. 5. Two of the hydraulically actuated heads are equipped with double spindles. The illustration shows the machine with the various tool-bars partially

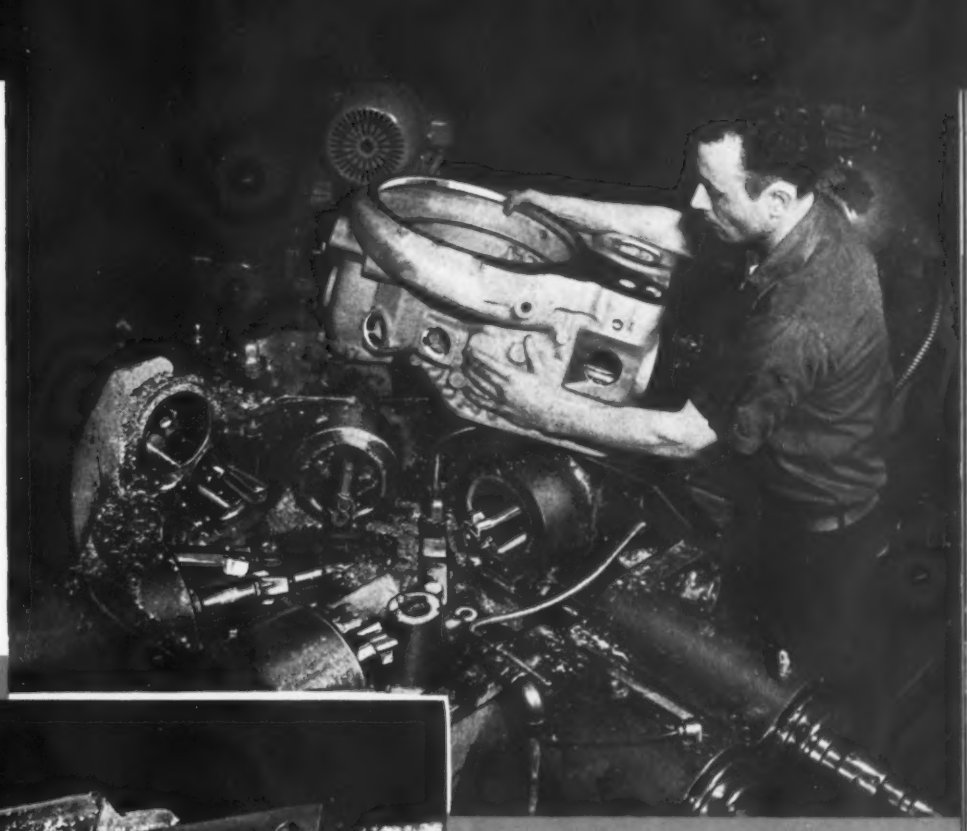


Fig. 5. (Right) Multiple-spindle Machine Designed for Simultaneously Boring Nine Holes in the Accessory Housing

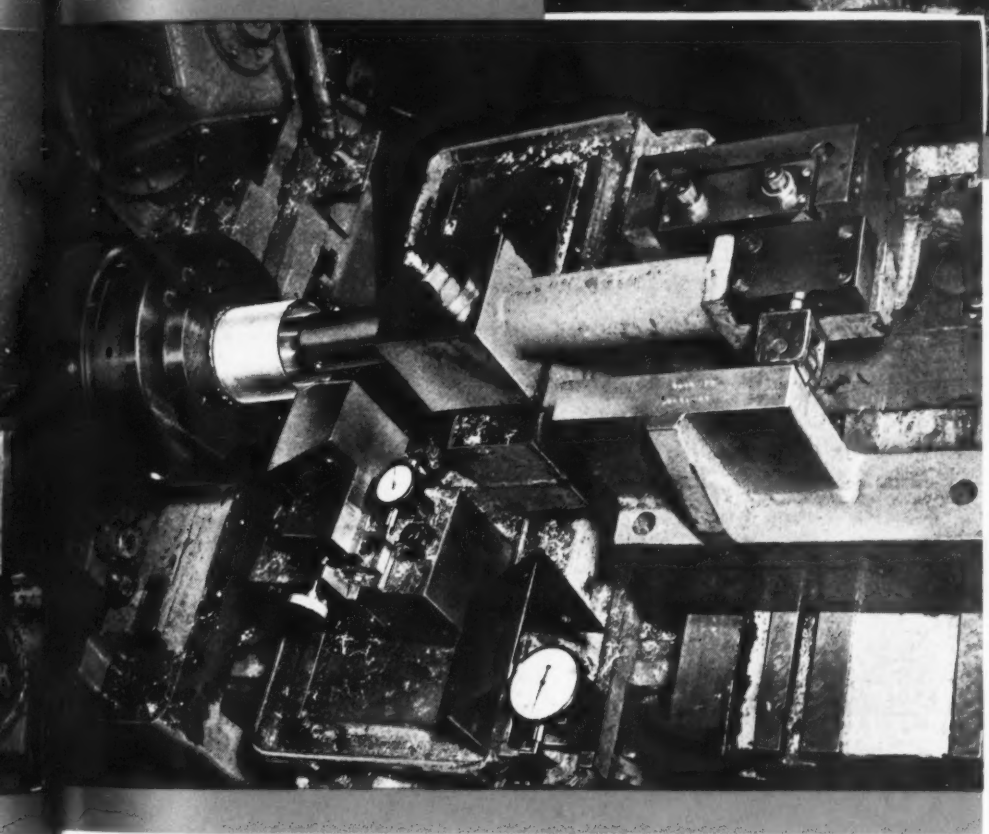


Fig. 6. (Left) Silver-plated Bearings with Thin Walls are Crowned on Inside and Turned on Outside in a Bore-Matic Equipped as Shown in This Illustration

withdrawn and the operator removing an accessory housing from the fixture. Each tool-bar is accurately guided by a cylindrical sleeve, approximately 6 inches in diameter. Two machines of this type are employed together, one for rough-boring and the other for finish-boring the accessory housings. The finish-bored diameters range from 1 1/2 to 3 inches, and they must be machined to size within plus or minus 0.0005 inch, while the center-to-center distances between holes must be held to plus or minus 0.001 inch. These castings are also of magnesium.

An operation in which both the outside and inside cylindrical surfaces of a thin-walled bearing must be turned to size within a total tolerance of only 0.0005 inch and concentric within a comparable tolerance is performed by the Heald Bore-Matic shown in Fig. 6. The part has been silver-plated on the surfaces to be machined when it reaches this boring and turning operation.

To attain the prescribed accuracy, it was found desirable to bore and turn simultaneously. While the turning cut is being taken by a tool

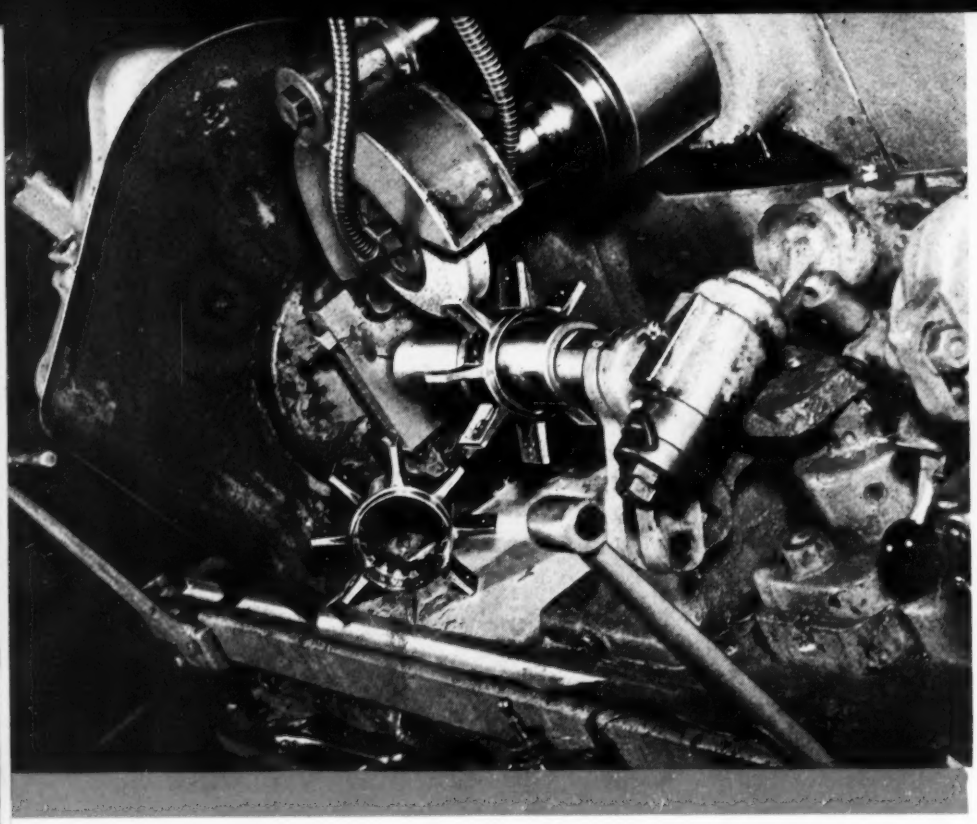


Fig. 7. Finishing the Blades on Inner Member of Vibration Dampeners and Root between Blades with a Form Grinding Wheel

mounted on the front of the carriage, the part is also bored by a tool on an arm that is attached to the center of the carriage. This arm is swiveled, as the inside of the bearing is crowned from both ends. In starting the cut, the tool is fed radially inward toward the axis of the spindle as it moves along the part for a distance of approximately 1 inch, so as to cut to a taper. The tool is then fed straight across the center of the part, and finally is fed radially outward for machining the taper on the left-hand end of the piece.

The radial movements of the boring cutter are obtained by swinging the arm on which the cutter-bar is mounted. This arm is equipped with a hardened and ground block at the right-hand end, which has a V-projection that is held in contact with a cam bolted to a member of the machine which is held stationary. A roller on the opposite side of the arm from the V-projection runs along the finished vertical face of a bracket to hold the V-projection constantly against the cam. Thus, the tool is swiveled sidewise in accordance with the cam contour as it is fed through the work.

Actual diamond tools are used to obtain a high finish on the silver surface. The minimum inside diameter must be 3.2566 inches within plus

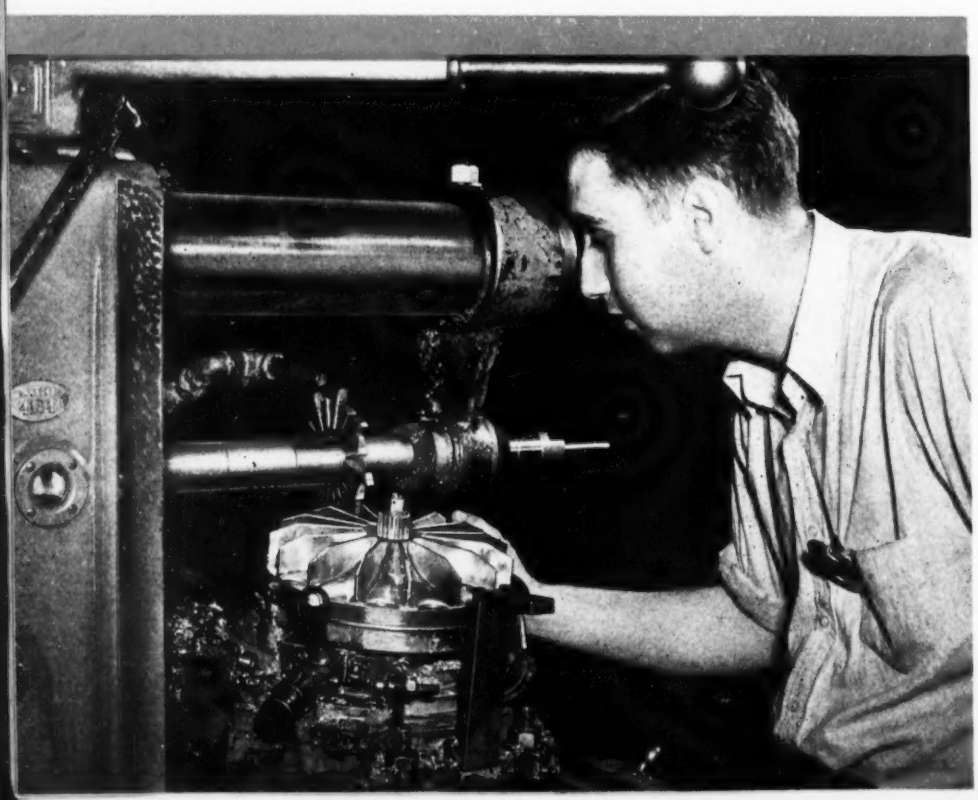


Fig. 8. Milling Set-up for Finishing Blades of Supercharger Impellers to the Required Thickness and Removing the Stock between Them

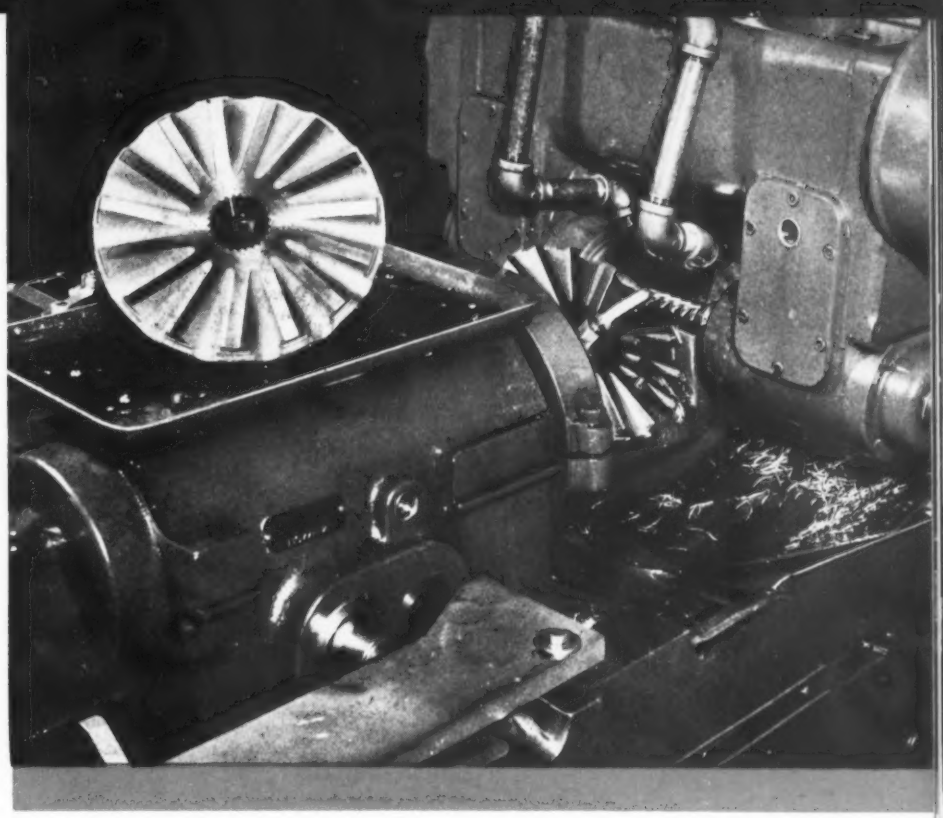


Fig. 9. First of Eleven Operations Performed in Rough- and Finish-milling the Vanes of Supercharger Rotors from Solid Castings

0.0005 inch, minus nothing, while the outside diameter must be 3.4689 inches, plus nothing, minus 0.0005 inch. The part is held concentric with the machine spindle by seating the finished face on one end into a recess in the magnetic chuck. A small pin in this recess engages teeth on the part to act as a dog.

The blades on the inner member of vibration dampeners must conform closely to the specified shape and dimensions. To finish these blades to the required accuracy, they are ground on gear-grinding machines, set up as illustrated in Fig. 7. The left-hand side of one blade and the right-hand side of the adjacent blade, as well as the root between the blades, are ground with each pass of the grinding wheel along the work, the wheel being dressed to the required contour. At the end of this operation, the root diameter must be as specified within plus nothing, minus 0.001 inch, while the total tolerance on the blade thickness is 0.006 inch. From 0.010 to 0.015 inch of stock is ground from the blades and the root surfaces. These work-pieces are milled on the blades before arrival at the grinding machines.

A novel arrangement has been devised for finishing the blades of supercharger impellers and the web between them. Fig. 8 shows this

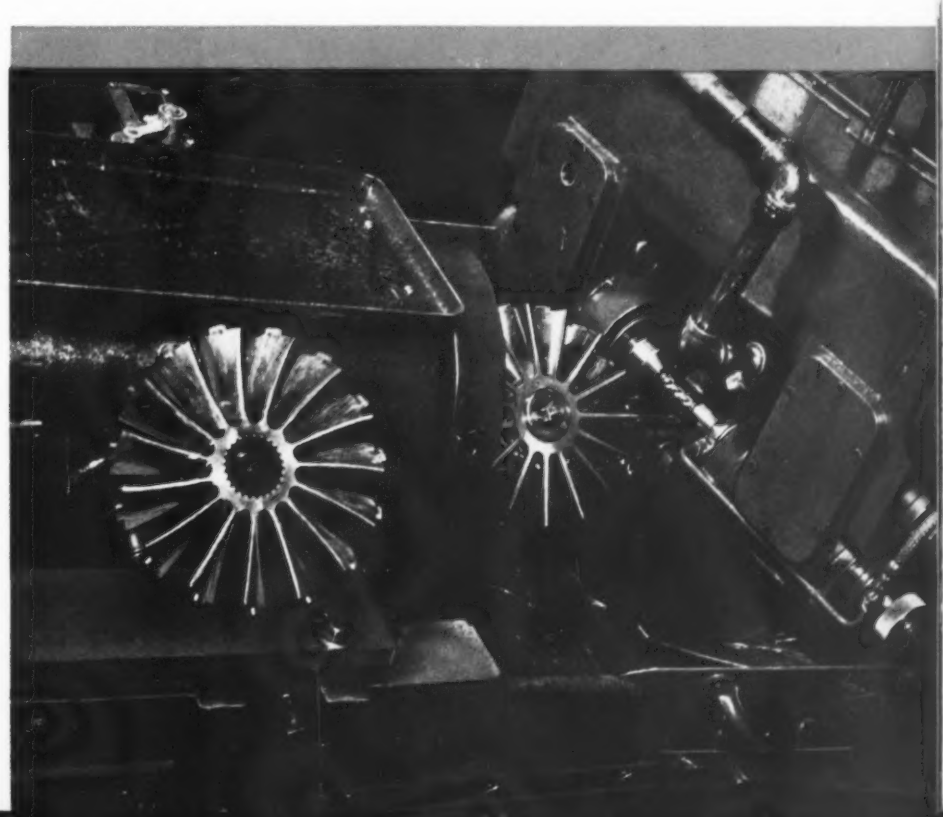


Fig. 10. One of the Finishing Operations on the Rotor Vanes, which Brings the Vanes to the Required "Twist" and Thickness

Fig. 11. (Left) Straddle Milling Operation on Crankcase Sections in which Carbide-tipped Cutters 20 Inches in Diameter are Employed

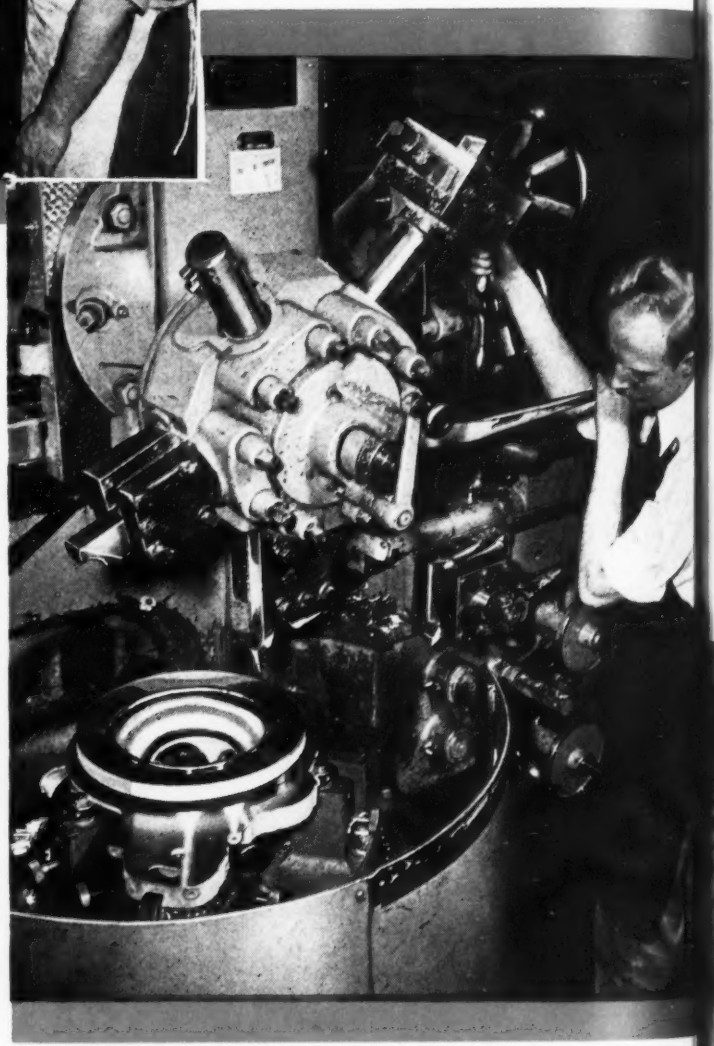


Fig. 12. (Right) Vertical Turret Lathe Set up for a Series of Boring, Turning, Facing, and Forming Cuts on Supercharger Inlet Covers

operation being performed on a Mil-Waukee-Mil. The work-piece is set up on an indexing fixture, which is fed into position with respect to a side cutting milling cutter, as shown. Then by means of two handles, the operator swivels the fixture back and forth between stops until the space between the two blades has been completely finished. The work is next withdrawn from the cutter by using the table feed, the fixture indexed, and the operation repeated. This cycle is followed until the impeller has been machined all the way around. The tolerance on the blade thickness is plus or minus 0.005 inch, while the tolerance on the thickness of the web between the blades is only plus or minus 0.003 inch. This high degree of accuracy is required because the weight and balance of the finished impellers are extremely important.

Eleven separate operations on DeVlieg milling machines are required for machining the vanes of supercharger rotors. These parts reach the first machine of the battery in the form of a steel forged disk, as seen on top of the work-slide in Fig. 9. In the first operation, a helical milling cutter of small diameter, supported at both ends as illustrated, hobs the stock from between the blades as the work-slide advances the part to the cutter.

During this advance movement, the work-spindle is swiveled so that the vanes will be milled to the required shape. This swiveling action is obtained through cams at the front and back of the bed, which are contacted by a

plunger that extends through the work-slide. A worm mounted on this plunger engages a worm-wheel on the work-holding spindle and causes the latter to be rotated as movements are imparted to the worm by the inclined surface on the cams. Limit switches control the forward and backward movements of the work-slide. With each return movement, the work-spindle is automatically indexed to bring the work into the proper position for milling the succeeding vane during the next forward movement of the work-slide.

Fig. 10 shows one of the finishing operations on the supercharger vanes. It will be noted that the cutter being used for this operation is similar to that employed for the first cut. In some operations, however, a short form milling cutter is employed that is supported at one end only. The rotors, like the supercharger impellers, must be within close balance at the end of the vane milling operations. A tolerance of plus or minus 0.015 inch is specified for the blade thickness, but the tolerance on the shape of the blades is considerably closer.

Boring, turning, facing, and forming cuts are taken on supercharger inlet covers by the Bullard vertical turret lathe shown in Fig. 12. This part is a magnesium casting. The boring cuts are taken by tools mounted on the turret, while the wide bottom face is finished by a tool on the side-head. The top flange is dished by a tool mounted on a slide attached to one of the turret faces. This tool is fed sidewise at the required angle during the cut by a block on the side-head. A form cutter on the turret finishes the curved surface on the inside of the casting. The tolerance on the height from the top face to the wide face is plus 0.002 inch, minus nothing, and the same close tolerance is specified on the distance from the top shoulder to a tapered surface on the inside of the casting, and also on the outside diameter of the top shoulder.

Carbide-tipped straddle milling cutters, 20 inches in diameter, are used on the Ingersoll milling machine shown in Fig. 11 for simultaneously finishing opposite ends of both the center and outer crankcase sections. The castings are accurately located on fixtures which are fed between the cutters. Each cutter is equipped with thirty-four blades. Two of the blades are raised 0.005 inch higher than the others for taking finishing cuts. The crankcase sections are aluminum castings.

A Cincinnati straddle milling machine equipped with cutters of the same size and type as those just described is used for milling the joint or split-line faces on the center crankcase section. Such an operation is illustrated in Fig. 13. On each side the castings are milled along narrow flanges that extend along each top and bottom edge when a casting is set up as shown, and also on top of the bearing joint surfaces. Both sides of the casting are finished at one time, the cutter-spindles being inclined at an angle to correspond with the angular planes to which the various surfaces must be finished. Hardened and ground blocks are provided on the fixtures used both in this and the preceding operation for setting the milling cutters to the correct height with regard to the work.

Fig. 13. Another Straddle Milling Operation with Large Carbide-tipped Cutters, which Finishes the Split-line Faces on Opposite Sides of the Center Crankcase Sections

An Assembly Line in a Ford Plant Turning out Turbo-superchargers that Give American-built Planes Distinct Advantages over Enemy Aircraft — They "Lift the Ceiling" for Heavy Bombers

Airplane Engines and Turbo-Superchargers

BY FORD PRODUCTION METHODS

By CHARLES O. HERB

Methods Employed by Ford in Producing Pratt & Whitney Aircraft Engines and Turbo-Superchargers which Enable Planes to Operate at the Extreme Heights that are Battle Areas in the Present War

THE Ford Motor Co. has become a most important factor in the nation's aircraft industry. Attention has been focussed on the huge Willow Run plant, which turns out heavy bombers, because of the application of mass-production methods, based on years of experience in automotive manufacture. But this company has also achieved remarkable success in building Pratt & Whitney eighteen-cylinder double-row engines of 2000-H.P. rating. Several plants located in various cities in the Middle West that were formerly used for the assembly of automobiles are now turning out the thousands of different parts required for these radial air-cooled engines. These parts are assembled into complete engines in a factory building in the Rouge plant, which was originally built both for manufacturing the parts and assembling the engines.

The Ford Motor Co. is also manufacturing turbo-superchargers in a department that has been set up in a former sheet-metal stamping plant. These turbo-superchargers are intended for forcing great quantities of air into the engines of airplanes flying at the extreme heights that have become battle areas in the present war, and are giving American-built planes distinct advantages over enemy aircraft. The turbo-superchargers are really air compressors for supplying the engine cylinders with charges of air and fuel at higher pressures and greater densities than would be normal at flight

ENGINES AND

Fig. 1. First Drawing Operation on the Inlet Half of Supercharger Housing Draws Irregular Contours to a Maximum Depth of 4 Inches

altitudes. They appreciably increase the engine horsepower at all heights.

Turbo-superchargers are driven by a turbine wheel which is actuated by the exhaust gases of the airplane engine. This is in contradistinction to the integral supercharger provided in aircraft engines that power practically all aircraft operating at moderate altitudes and that are gear-driven from the engine crankshaft. Turbo-superchargers maintain sea-level pressure at heights above 25,000 feet. They are the result of many years of experimentation by Dr. Sanford A. Moss, consulting engineer of the General Electric Co.

These turbo-superchargers are being manufactured by several concerns besides the Ford Motor Co. The Ford product differs from the others in a number of important respects, due principally to the automobile industry's approach to a mass-production problem. One out-

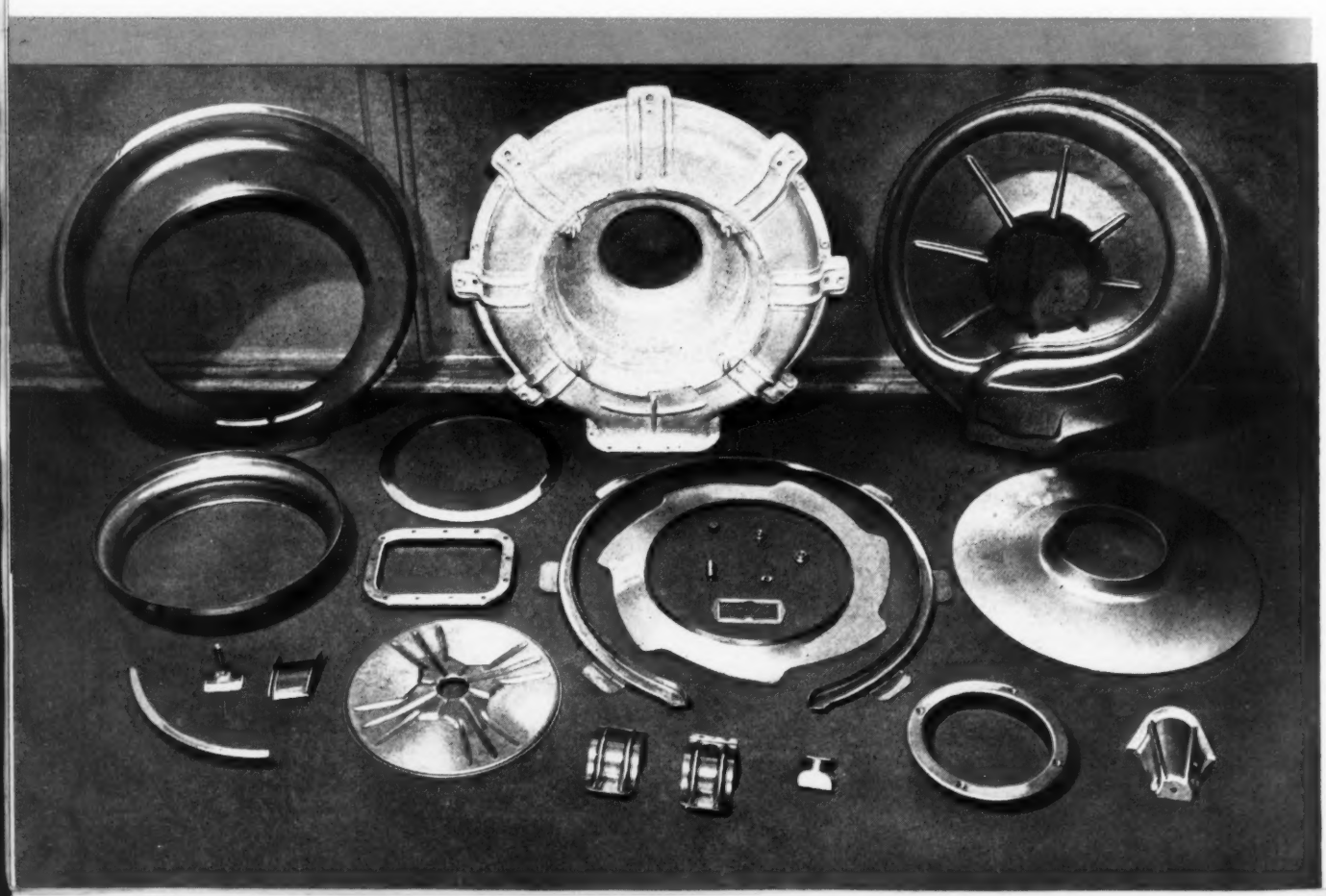


Fig. 3. Second Drawing Operation on Inlet Side of Housing Produces Sharp Corners at Bottom of Cavities and Forms Radial Ribs

standing difference is the fabrication of the supercharger compressor casing from ordinary fender steel—a practice that saves 37 pounds of the critical material aluminum in every unit built. Several thousand turbo-superchargers have already been produced in the Ford plant and installed on Flying Fortresses, Liberators, and Lockheed Lightnings.

The press work entailed in fabricating the sheet-metal housing will be apparent from Fig. 2, which shows an assembled cadmium-plated housing in the rear center, together with examples of the parts required in making such an assembly. At the right-hand end of the middle row is seen a circular part which has a flat rim that must not have a run-out exceeding 0.005 inch when the part has been assembled in the housing. Such a tolerance is unheard of in press work.

It will be observed that stiffening brackets are spot-welded to the outside of the housing on the outlet side. Formerly, the practice was to attach these brackets by arc-welding all around their edges. Spot-welding was adopted because it enables the operation to be performed quickly and insures close adherence of each bracket to the housing all over, instead of only along the edges of the bracket.

Fig. 2. (Left) Different Types of Stampings Required to Make a Completely Assembled Housing for Ford Turbo-superchargers, as Seen in the Rear Center. By Making This Part of Sheet Steel, 37 Pounds of Aluminum are Saved on Each Unit

Fig. 4. (Right) Stiffening Brackets are Spot-welded to the Outlet Half of the Supercharger Housing with 29 Welds Each

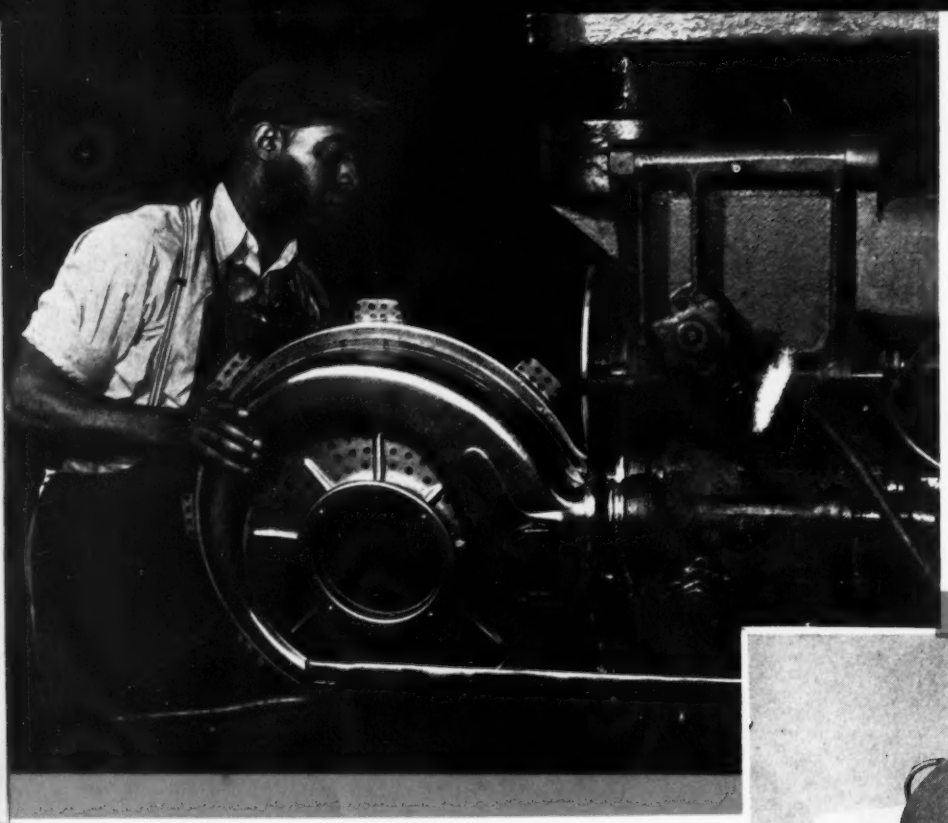


Fig. 5. (Left) Seam-welding the Rectangular Discharge Flange to the Supercharger Casing after the Inlet and Outlet Sides have been Welded together

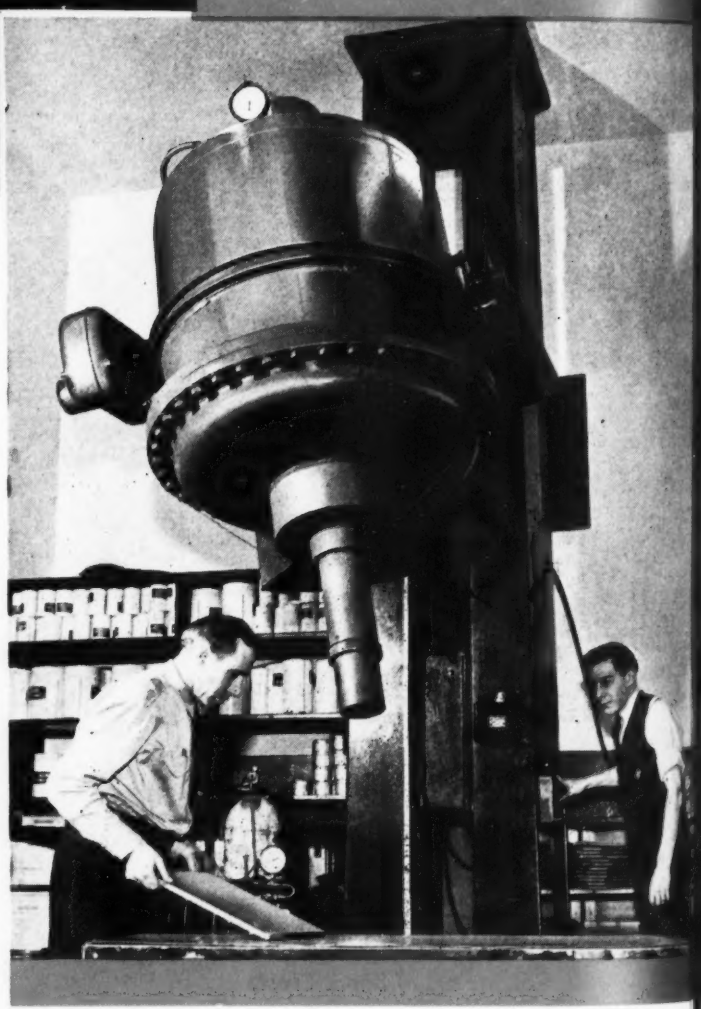


Fig. 6. (Right) An X-ray Machine of 1,000,000 Volts which can Penetrate 5 Inches of Metal in Five Minutes

The inlet half of the housing, seen at the rear right, is the most unusual of the stampings as far as shape is concerned, and is now being satisfactorily produced only after much experimentation. In addition to the irregular contours, the corner at the bottom of the rather deep draw has a fillet of only about 1/4 inch radius, which complicates the drawing operation considerably.

The first operation on this part is performed on a heavy Bliss mechanical press of double-action type, equipped with dies for forming a flat blank to the shape shown in Fig. 1. In the operation, a blank-holder first descends and grips the blank firmly on the face of the die, pressing it into a groove, so as to obtain a maximum gripping pressure. The part is drawn to the shape shown as the ram completes its stroke, the greatest depth of draw being approximately 4 inches.

The stamping is then transferred to a second Bliss press, as shown in Fig. 3, for drawing to the sharp corners, forming the stiffening ribs that radiate from the center of the stamping, and restriking to the final dimensions. Later operations trim off the excess stock.

The outlet half of the housing, seen at the left end of the rear row in Fig. 2, is produced on the same presses equipped with different dies. In the initial drawing operations on these housing sections, a heavy lubricant is wiped on top of the blank and in the die cavities to aid the drawing action.

Spot-welding of the stamped brackets to the outlet half of the housing is performed on ma-

chines of the type shown in Fig. 4. Seven brackets are attached to a section, each one with twenty-nine spot-welds.

The roller seam-welder seen in Fig. 5 is employed to weld the discharge flange to the supercharger housings. Continuous welds are made around the rectangular throat as the work revolves between a small roller electrode about 2 inches in diameter, which is within the housing, and a large roller electrode, approximately 10 inches in diameter, which runs on the outside of the work. All together, twenty different parts are welded together in the same department in fabricating the supercharger housings. A total of 704 spot-welds, 195 inches of seam-welding, 71 inches of arc-welding, and 17 projection welds are made on each housing.

The remaining illustrations show some of the operations involved in building the Pratt & Whitney aircraft engines. Extreme care is taken to see that all parts meet specifications as to strength. To enable the various parts to be carefully checked, there has recently been installed a 1,000,000-volt X-ray machine, which is illustrated in Fig. 6. This machine can take X-ray photographs through 5 inches of metal in 5 minutes, whereas the 400,000-volt X-ray machine previously used required several hours to take a similar picture.

All welded parts and some castings, such as the cylinder heads, are X-rayed under the 140,000-volt Thermax X-ray unit illustrated in Fig. 7. Between 75 and 100 cylinder heads are checked under one of these machines every day.

Fig. 7. (Left) All Cylinder Heads are X-rayed on the 140,000-volt Unit Shown in This Illustration

Fig. 8. (Right) X-ray Films are Conveniently Studied by Mounting Them on Screens Placed in Front of Strong Lights

Fig. 9. (Left) Impeller Assemblies which Run at 25,000 R.P.M. under Ordinary Flying Conditions Must be Balanced within 0.3 Ounce-inch

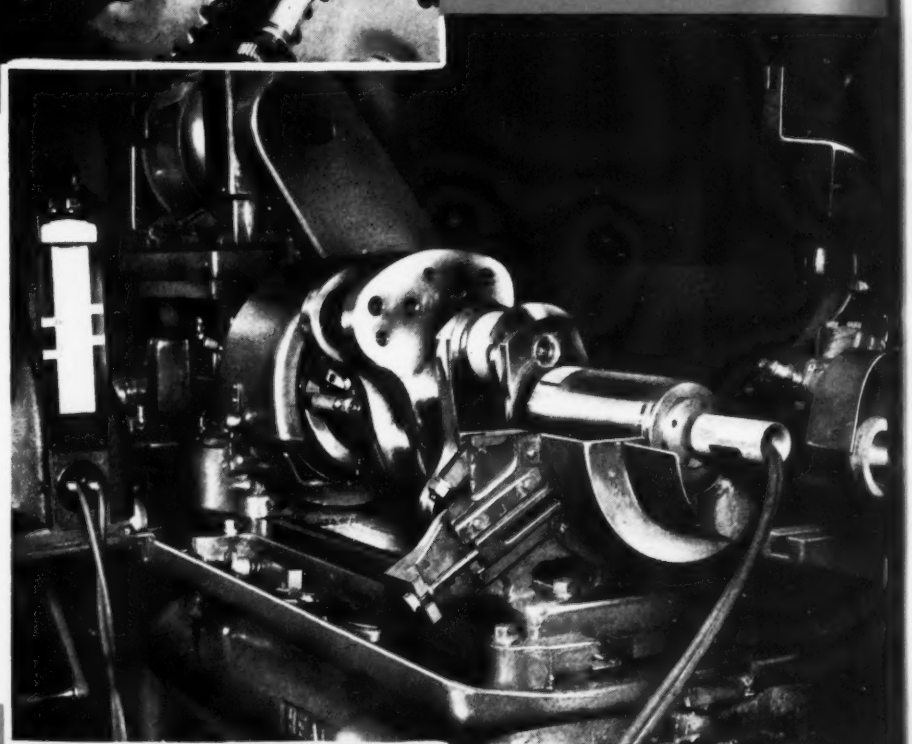


Fig. 10. (Right) Checking a Bore on a Crankshaft Front Section by Means of an Air Gage while the Part is Still in the Machine

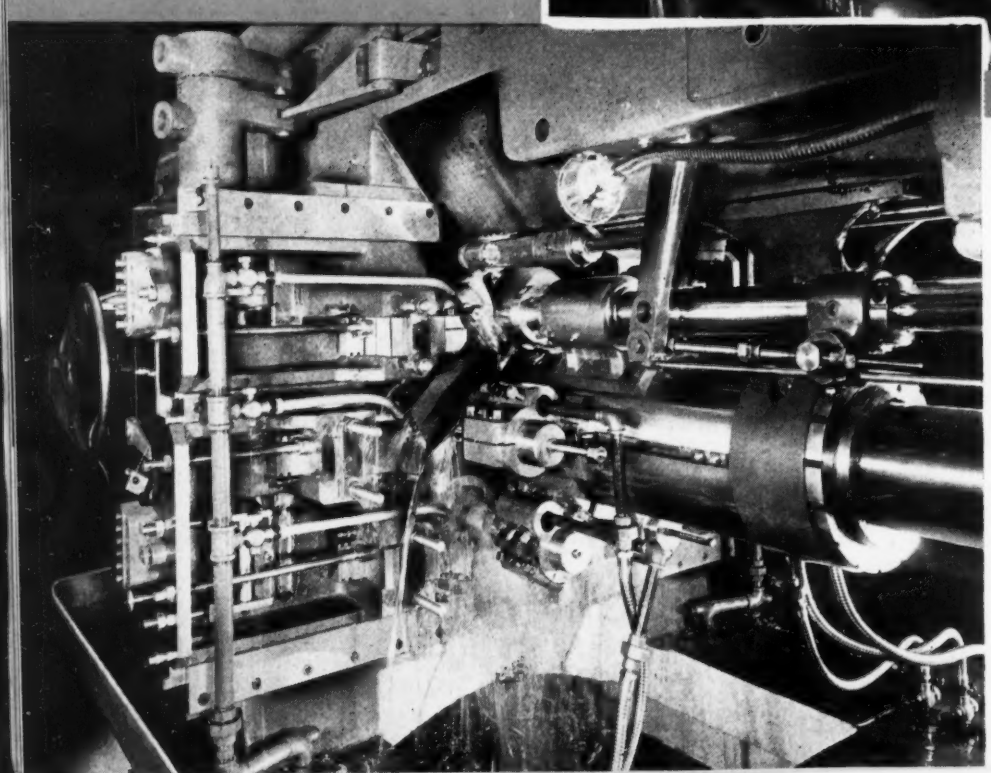


Fig. 11. (Left) Gear Blanks of Various Types and Sizes are Turned Out at High Production Rates in Automatic Screw Machines

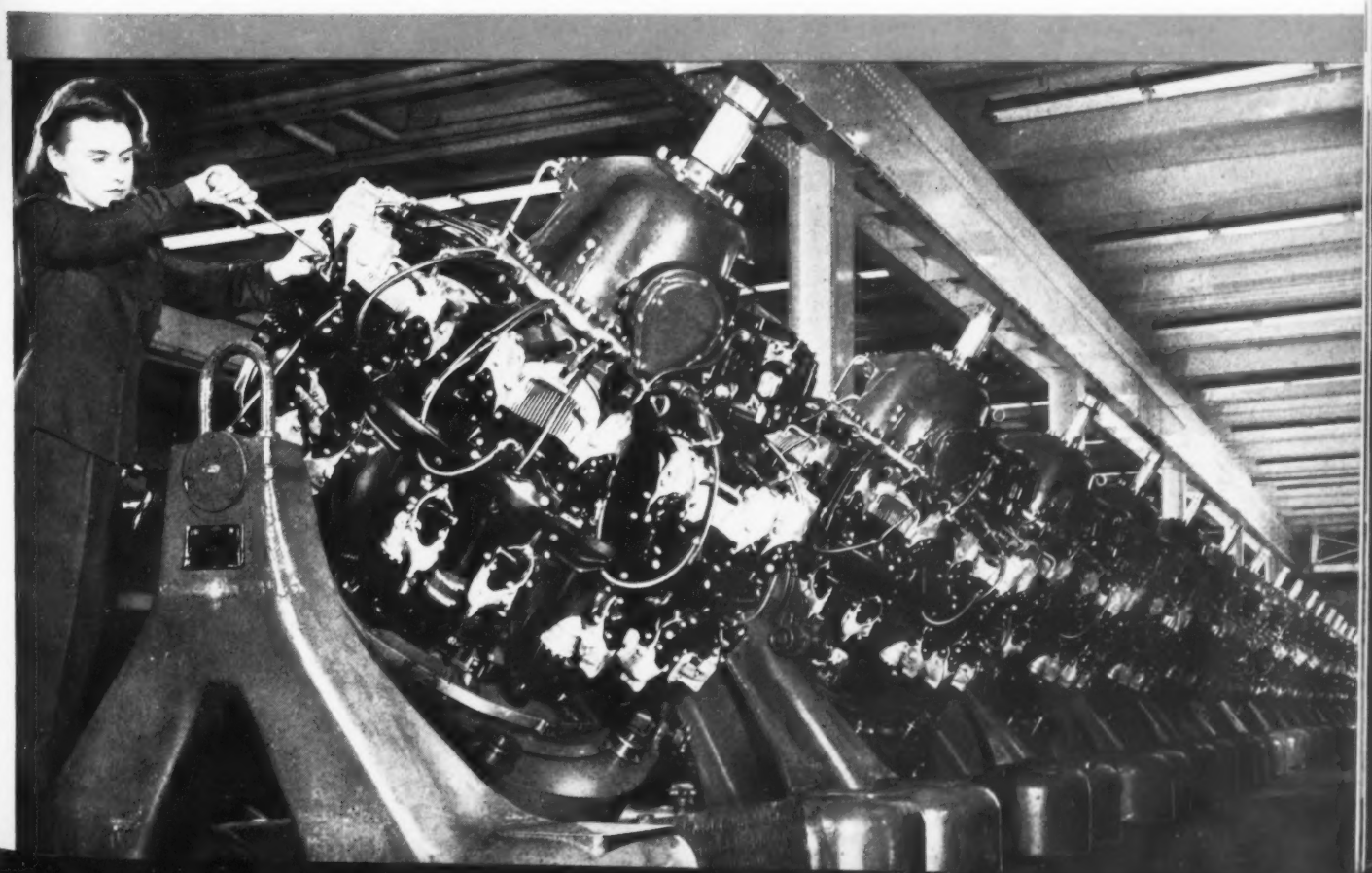
Fig. 8 shows how X-ray films are mounted on screens in the laboratory for convenient examination. Strong lights placed in back of the screens bring out clearly the smallest defects in the objects being studied. The two negatives seen mounted on the screen are pictures of bearings and bushings. As many as three to four thousand films are examined each day in the X-ray laboratory.

One of the most important factors in airplane engine manufacture is close balance of the rotating parts. In Fig. 9 is shown a machine used in checking the balance of impeller assemblies, which run at about 25,000 R.P.M. under ordinary flying conditions. The balance of these impeller assemblies must be perfect within 0.3 ounce-inch before they are released to the assembly department.

In grinding internal surfaces on the front section of the crankshaft, the accuracy of the operation is closely checked by the use of an air gage. Fig. 10 shows such an inspection being made on a crankshaft section set up on an internal grinder. The operation of this gage is based on variations in the volume of air at constant pressure that flows between the nose of the gage and the sides of the bore being inspected. Compressed air from the regular plant supply is used. The amount of air that escapes depends upon the size of the hole. Therefore, the exact size of the ground bore can be readily determined by the air flow, as indicated by the gage seen at the left of the machine. The gage not only checks the diameter of the bore, but also indicates the location and amount of any out-of-round, tapered, or bell-mouthed condition. Bores on the crankshaft section must be finished to within 0.0001 inch of the specified diameter.

Gear blanks of various types and sizes are turned out at high production rates through the use of automatic screw machines. A typical operation on one of these machines is illustrated in Fig. 11. All six stations of the machine are tooled up for the performance of two and three operations, so that when the blanks leave the machine they are ready to have the teeth cut.

Fig. 12. Fully Assembled Ford-built Pratt and Whitney Aircraft Engines are Shown Lined up Ready for Pre-oiling preparatory to the "Green Run." Spark Plugs will be Inserted after Pre-oiling, a Step that Fully Lubricates the Engine Parts and Serves as a Check for Oil Leaks



Curtiss-Wright's

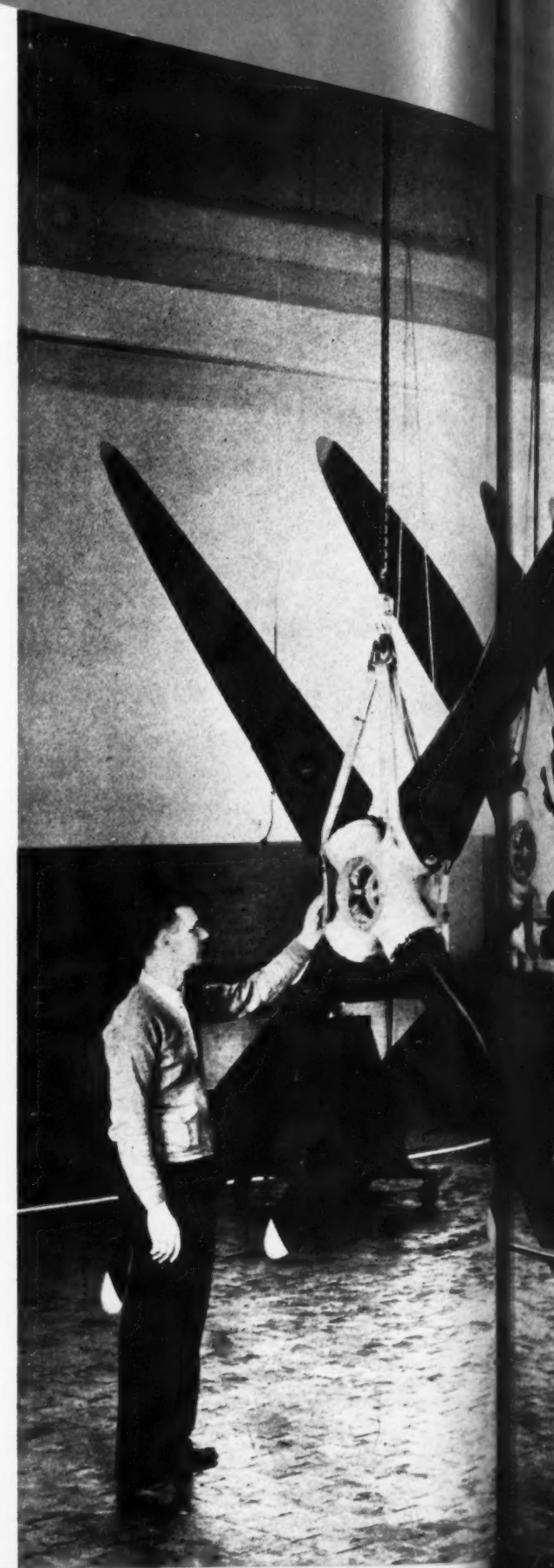
A MARVEL OF

WHEN the huge present-day requirements for airplane propellers necessitated the construction of another large plant, the management of the Curtiss-Wright Corporation achieved new heights in efficient planning. This plant, built in Indianapolis, is one of the most modern industrial plants in the world. Work-handling has been eliminated as a problem through the installation of several miles of conveyors; the latest types of manufacturing equipment insure maximum production of propeller parts of high quality; and complete air-conditioning in the assembly plant provides maximum comfort for workers, and promotes cleanliness of work in process.

The production of propeller hubs, gears, and other small parts is conducted in a five-story machine shop formerly owned by the Marmon Co., which has been completely modernized inside. One of the features of this building is a continuous overhead conveyor that travels back and forth on all floors to carry parts between machines and departments, and then passes out of the building and continues several hundred yards to the finished stores department of the so-called "assembly" plant. This conveyor carries suspended trays about 5 feet apart, on which boxes of small work can be loaded for transportation to various destinations.

All propeller assembly is conducted in the air-conditioned building, and there, also, all aluminum-alloy propeller blades are completely machined from rough forgings, propeller parts are anodyzed or dipped in dichromate, and blades and other parts are painted. The building is of large size. It is completely air-conditioned and of windowless construction. It was not feasible to provide these features in the machine shop building already constructed.

Each tray of the continuous conveyor that serves the machine shop is provided with a metal box in which there are fifteen swiveling fabrikoid tabs with numerals painted on them to identify the stations at which the work-pieces are to be unloaded. These tabs can be swung

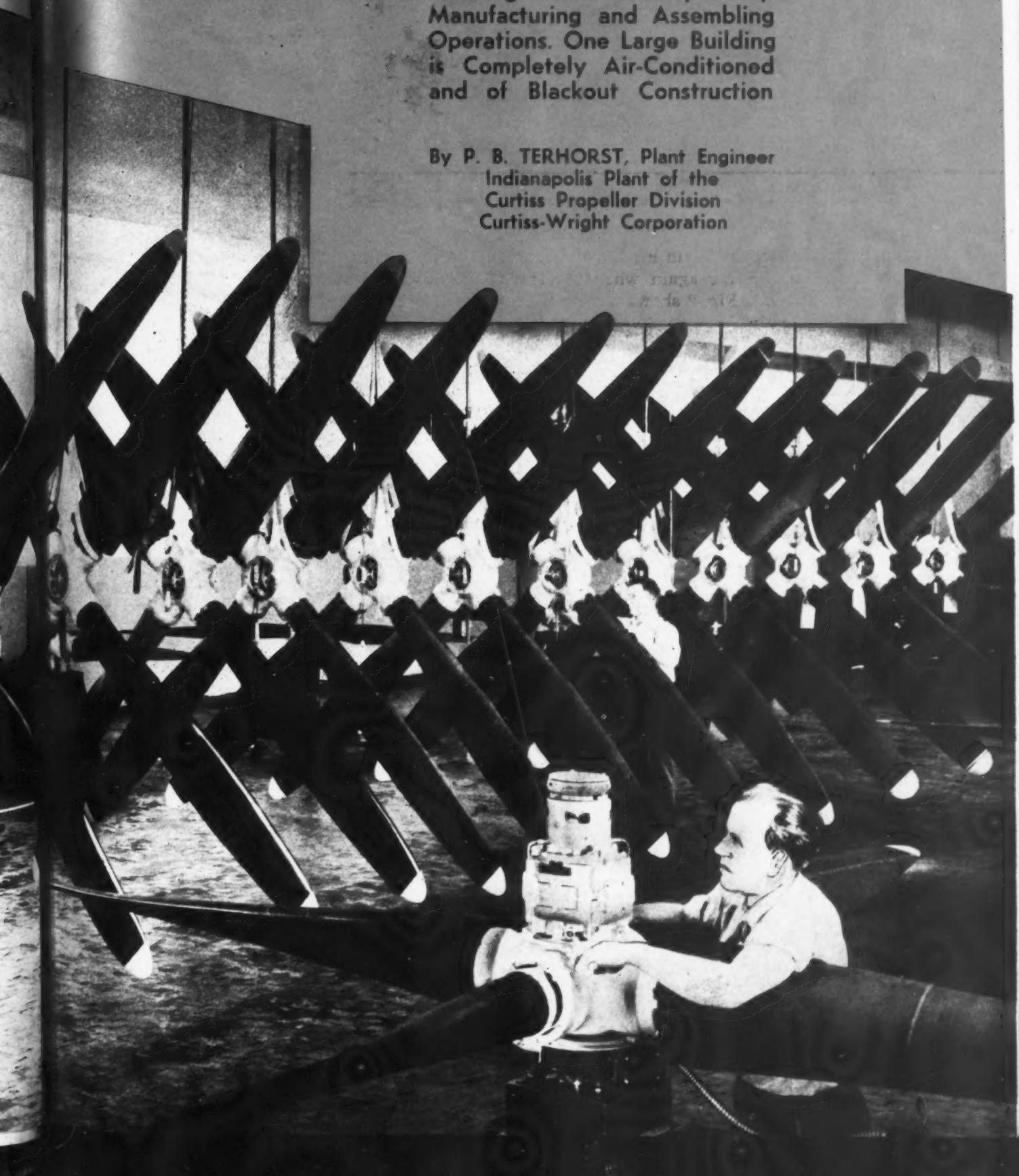


s Newest Propeller Plant

F MODERN PLANNING

Miles of Conveyors Eliminate All Trucking of Work and Speed up Manufacturing and Assembling Operations. One Large Building is Completely Air-Conditioned and of Blackout Construction

By P. B. TERHORST, Plant Engineer
Indianapolis Plant of the
Curtiss Propeller Division
Curtiss-Wright Corporation



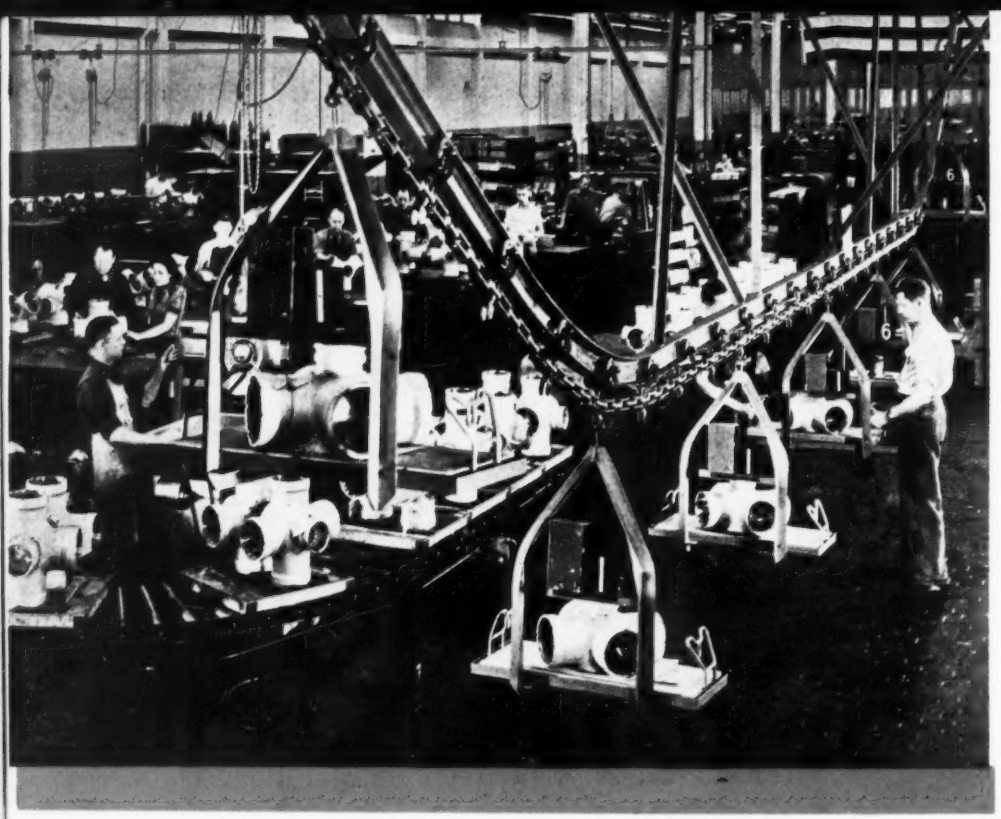


Fig. 1. Power-driven and Gravity Conveyors that Have a Total Length of Several Miles Greatly Expedite Production in the Latest Curtiss Propeller Plant

CURTISS-WRIGHT'S

down conveniently, as seen in Figs. 1 and 2, and pushed up into the box again when the trays have been unloaded. Fig. 2 shows a view of this conveyor in the finished stores department of the assembly building. Here the finished parts are unloaded and stored on metal shelves until requisitioned by the assembly departments.

The work is sent to those departments on a similar conveyor which extends along the opposite end of the finished stores department. The second conveyor carries all parts except the propeller blades. The finished stores department occupies two floors of the assembly building, and both of these floors are served by the incoming and outgoing overhead tray conveyors. One of the advantages of an overhead conveyor of this type is that the track can be conveniently arranged to carry work to various levels. Fig. 1, for example, shows the conveyor coming from a much higher level in the background of the illustration to a floor station and then again rising to a higher level.

Steel propeller blades are customarily fitted with sheet-aluminum cuffs near the shank end to induce air agitation in addition to that normally set up by the blades, so as to provide greater air circulation to the engine for cooling purposes. These cuffs consist of three parts—

Fig. 2. An Overhead Conveyor that Serves All Five Floors of the Machine Shop Building and Carries Work to Finished Stores in the Assembly Building

a skin, support, and stiffener, the two latter parts being magnesium castings.

The skin is worked to the desired shape and the three parts fitted together and drilled on benches that extend at right angles along the broad belt type conveyor illustrated in Fig. 3. As the cuffs near completion, they are placed on the conveyor and carried to girls at the far end who perform additional operations, after which they are returned to the conveyor and carried to inspectors.

The cuff parts are then hung individually on the hooks of an overhead chain conveyor and transported to a room that is completely shut off from the remainder of the building by steel and glass partitions. Here the skins are removed from the conveyor and hung on racks, as seen in Fig. 4, for anodyzing and rinsing operations. There are five anodyzing tanks and six rinsing tanks in the department, each tank being about 10 feet long by 4 feet wide by 4 feet deep. After this operation, the cuff skins are again placed on the hooks of the conveyor that brought them to the anodyzing room.

In the meantime, this conveyor has carried the corresponding supports and stiffeners through an alkali washer, a tank of hydrofluoric acid, a cold water rinse, and a dichromate dip tank 35 feet in length. This conveyor travels back and forth three times in the dichromate bath, a view of which is illustrated in Fig. 5, so as to conserve space. After the parts have been carried through another washer and a lukewarm water dip, they reach the point where the cuff skins are again hung on the conveyor with their corresponding supports and stiffeners. The conveyor then returns all parts to the cuff department, where they are removed and given a mist coat of zinc-chromate primer.

After several riveting operations, the cuffs are suspended from another overhead conveyor to be transported to the painting department. This conveyor passes a station where duralumin and steel propeller blades are loaded between the hooks carrying the cuff parts. The blades are first masked on the shank end to guard against painting surfaces that must fit other parts. A Synthane plug and Neoprene cap are used to mask the hollow steel blades, while split cap castings are used for the duralumin blades.

In the painting department, the conveyor carries all parts through the long three-stage alkali

Fig. 3. Belt Conveyor that Serves the Cuff Fabricating Stands and Carries the Cuff Parts to Inspectors and the Head End of the Anodyzing Conveyor

CURTISS-WRIGHT'S

Fig. 4. (Left) Lifting Aluminum Cuffs for the Steel Propeller Blades from a Rinsing Tank after They have been Anodyzed

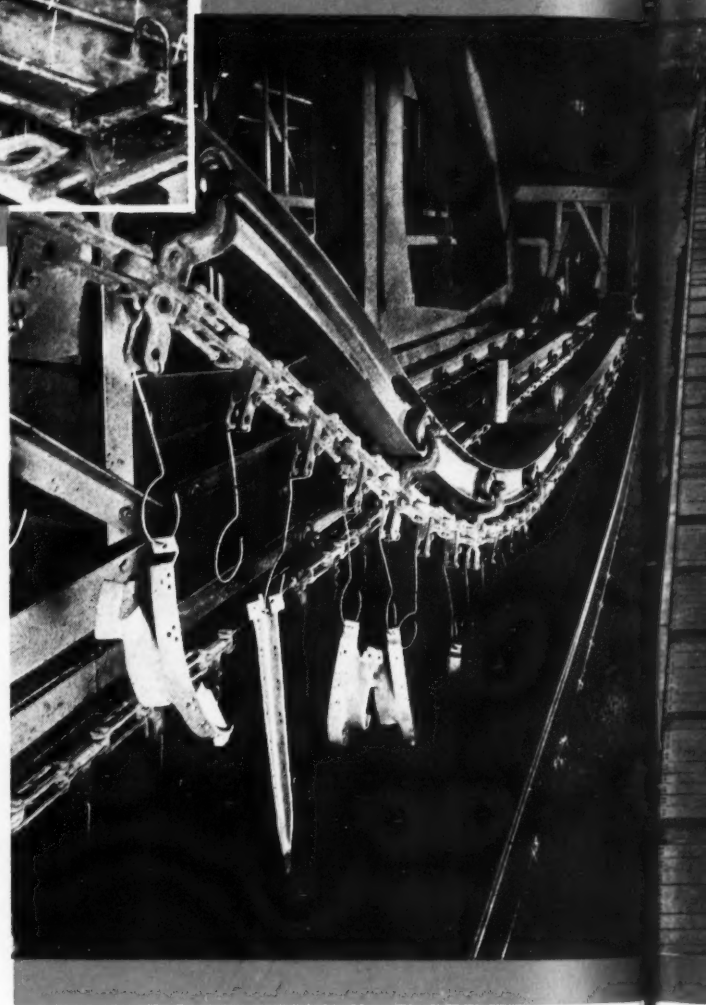


Fig. 5. (Right) View of the Cuff Conveyor Line as it Carries Supports and Stiffeners into a Long Dichromate Dip Tank

washer seen at the right in Fig. 6, and then through a drying oven of similar length, which is seen at the left. The parts are then carried in the open along the wall of the drying oven for a considerable distance to insure cooling before they reach two booths where a prime coat of zinc chromate is sprayed on them.

One of the booths is raised about 4 1/2 feet above the floor to facilitate the spraying of the smaller parts and short propeller blades, while the other booth, which is on the floor, permits convenient spraying of the lower end of the long blades. The arrangement is similar to that of the booths shown in Fig. 8, where a black enamel coating is later sprayed on.

The blades and cuff parts pass from the zinc-chromate spraying operation through an oven that bakes them for twenty minutes at a temperature of 190 degrees F. The conveyor backtracks in this oven, so that the parts come out of the oven at the same end where they entered. This arrangement reduces the oven length and saves one-half the floor space that would otherwise be required. There is then another cooling stretch before the parts reach the 20-foot long booth seen in Fig. 8, where the black enamel is sprayed on all parts as a finishing coat. Following the enameling, the parts make three passes back and forth in a long drying oven, in which they are baked for forty-five minutes at a temperature of 275 degrees F.

After again moving along a cooling stretch, the propeller-blade parts reach a short spray booth, where a yellow tip is painted on the outer end of the blades after a mask of scotch tape has been applied to the blades for a short distance above the area to be sprayed. This is done

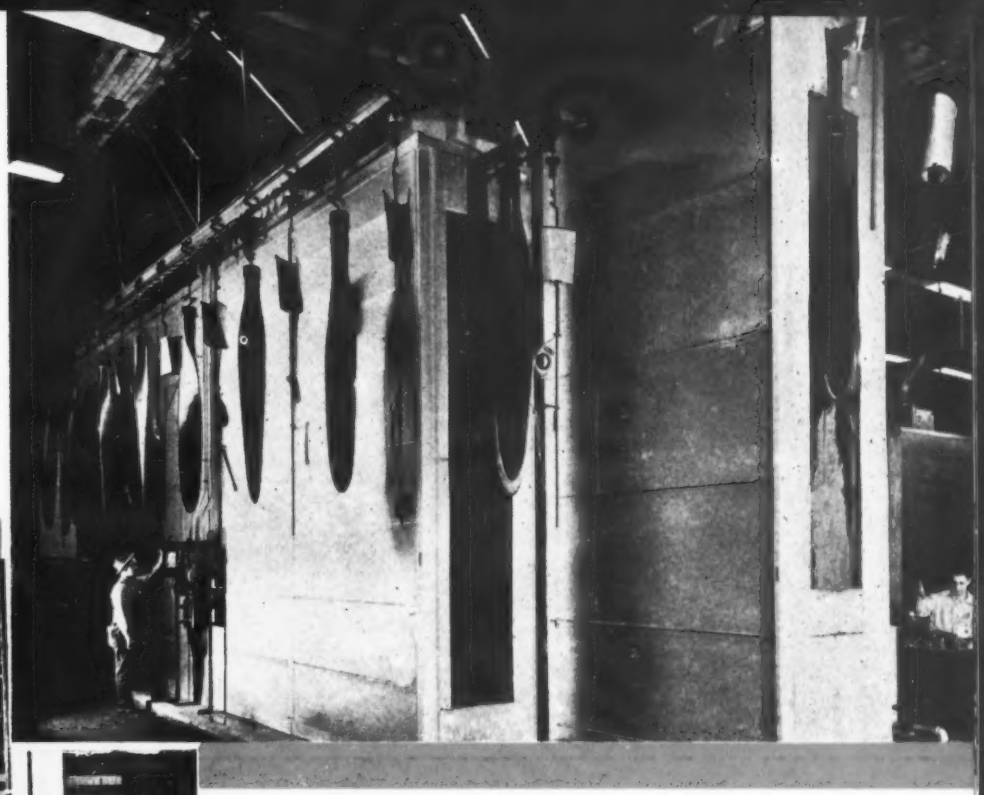


Fig. 6. (Right) In the Painting Room, Propeller Parts are Carried through a Long Washing Unit and an Adjacent Drying Oven

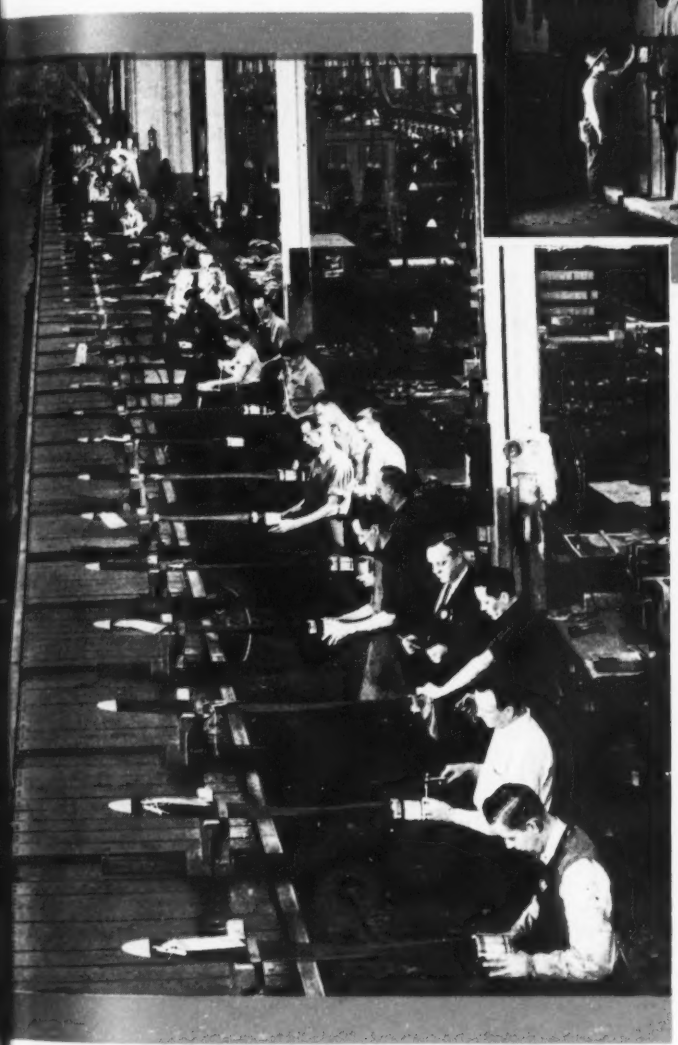


Fig. 7. (Left) Long Slat or Platform Conveyor where Propeller Blades are Assembled on a Real Quantity Production Basis

by a girl operator as the blades approach the spray booth on the overhead conveyor. The conveyor then carries the blades between the two banks of infra-red lamps seen in Fig. 10, for a three-minute baking period. There are seven rows of lamps in each bank, but only the rows of lamps are turned on that are directly in line with the painted blade tips. This set-up insures economy of operation.

To insure against dirt from other departments being carried by air into the painting and anodyzing rooms, both of these departments are supplied with clean air by a ventilating system that is separate from the air-conditioning system which serves the remainder of the building. The air in both of these rooms is maintained at a somewhat higher pressure than the air-conditioned atmosphere in the remainder of the plant, so that whenever the doors of the painting and anodyzing rooms are opened, a current of air flows outward and never into these rooms.

Fresh air is forced into the painting room at the rate of 132,000 cubic feet every minute when all of the paint spray booths and ovens are in operation, and is exhausted at the rate of 118,000 cubic feet per minute. There are ninety complete changes of air every hour. The input of air into the anodyzing room is at the rate of 60,000 cubic feet of air per minute, and the output at the rate of 50,000 cubic feet per minute. The fans that force the air into the painting and anodyzing rooms are accurately controlled by means of Pressurestats.

When the propeller-blade parts leave the painting room, the conveyor carries them across the head end of the assembly plant to the start-

Fig. 8. Arrangement of Two Spraying Booths at Different Levels so as to Facilitate Handling both Long and Short Blades

ing point of the slat conveyor illustrated in Fig. 7. This conveyor is provided with fixtures, about 4 feet apart, in which the blades are mounted horizontally for assembling the various component parts as the blades are moved along. The fixtures are made with an extension arm that can be adjusted to suit blades of different lengths. To insure that the slats will stand up well in service, their construction is unusually solid. The conveyor can be operated at various speeds to suit production requirements, which is true of all conveyors in the plant.

As the propeller blades are carried along this conveyor, the blade nut, bearings, drive-pins, gears, etc., are assembled. The cuff parts are mounted in place at a point where the cuff conveyor approaches this line. Balanced screwdrivers and nut-setters suspended over the slat conveyor speed up the various assembly steps.

The propeller blades finally arrive at a small paint spray booth seen in the right foreground

Fig. 9. Paint Booths and Batteries of Infra-red Lamps are Installed along the Platform Conveyor for Touching up the Assembled Blades

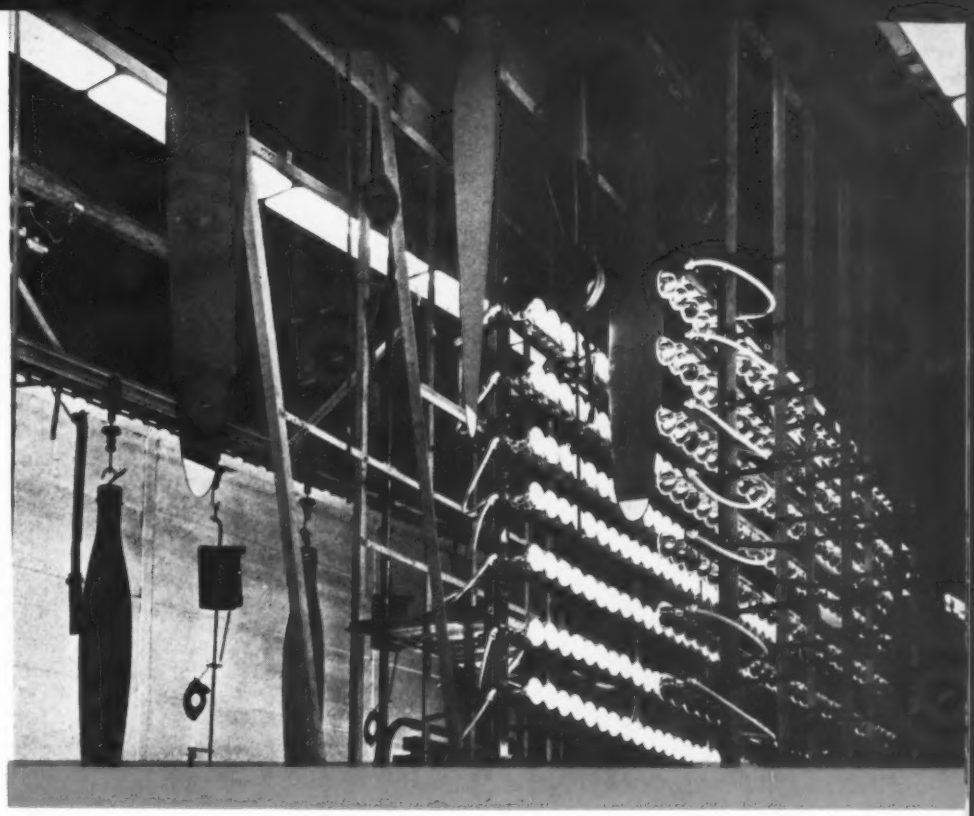


Fig. 10. After the Blade Tips have been Painted Yellow, the Blades are Carried through a Battery of Infra-red Lamps for Drying

of Fig. 9, where zinc chromate is painted on screws, rivets, etc., that have become scratched during the assembly operations. Then the blades are carried through the battery of infra-red lamps seen to the left of the spray booth, which is provided with three rows of twenty lamps each. Next, they pass the finish-painting booth seen at the left in the illustration and through another group of infra-red lamps, which insures complete drying of the blades before they reach the discharge end of the conveyor.

At the discharge end, there is a limit switch that stops the conveyor instantly if a fixture reaches this point with a blade still mounted on it or if any fixture should be extended to such a length that it could not pass under the conveyor for its return to the starting end. When the blades are removed from the slat conveyor, they are placed on overhead bridge cranes and transported to the final propeller assembly section.

Hubs are delivered from finished stores to the

Fig. 11. Eight Stands are Kept Busy in a Room Partitioned from the Remainder of the Shop for Accurate Balancing of the Complete Propellers

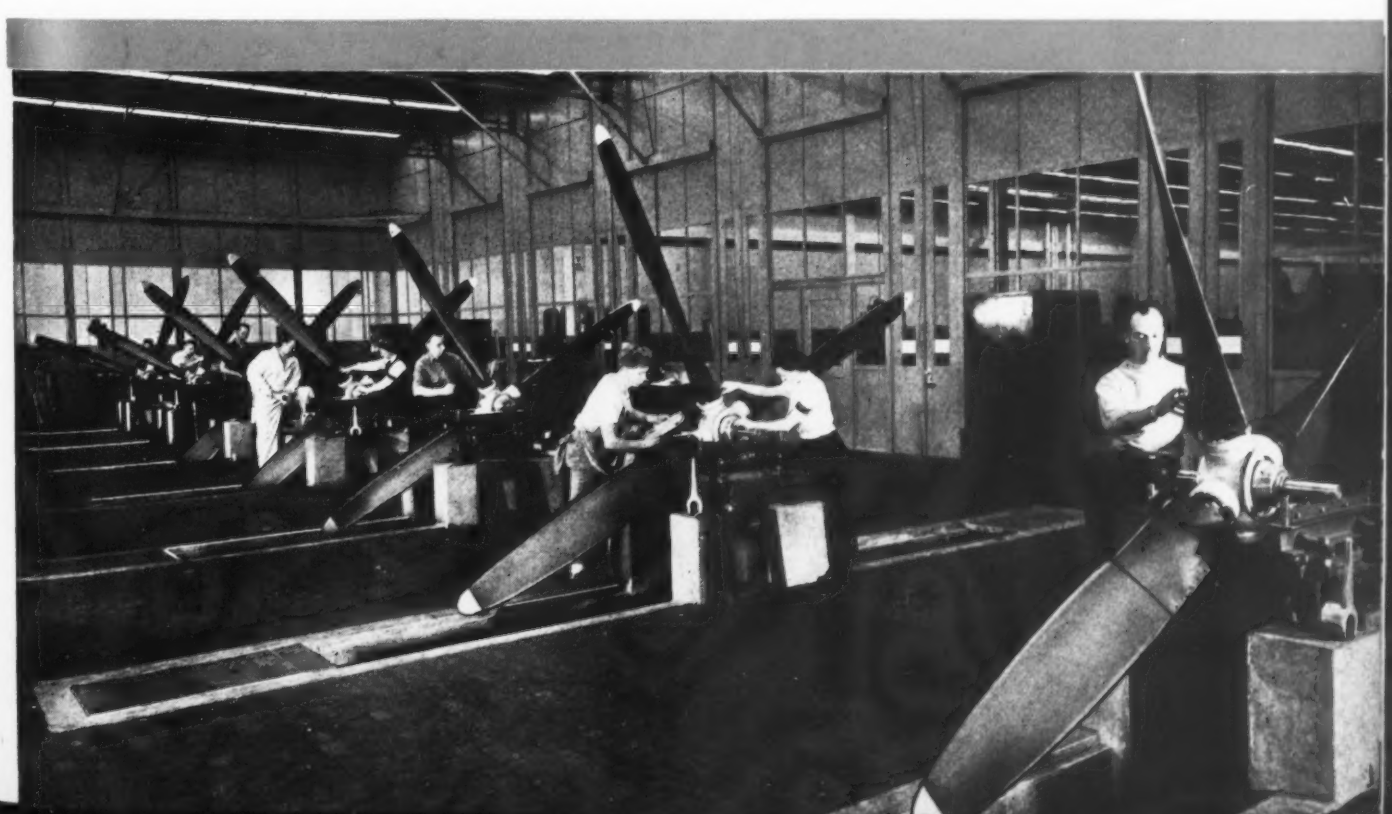


Fig. 12. Pneumatic Tubes Expedite Sending Orders and Requisitions back and forth between This Central Station and the Shop Departments

gravity roller conveyor seen in Fig. 1, which parallels the blade-assembly conveyor near the unloading end. After a slip-ring turning operation has been performed in engine lathes, the hubs are temporarily stored in adjacent bins until required by the propeller assembly section, which is several yards farther down the building.

Production requirements have not warranted the installation of conveyors for final propeller assembly, and such an arrangement would be somewhat difficult, because this phase of propeller manufacture needs heavy cast-iron tables. To facilitate handling the propellers through this department, several thousand feet of overhead Tramrail have been installed and a large number of Budgit hoists provided. After the propellers have been assembled, they are transferred by hoists to other tables on which the pitch range angles are set as specified for different types of airplanes and the adjustment devices permanently locked.

The propellers are then carried by the hoists to the large balancing room seen in Fig. 11, in which there are eight balancing stands located over pits. The pits are deep enough to handle propellers up to 26 feet in diameter, measured across opposite blades. This balancing room is also partitioned off from the remainder of the plant. Here the propellers are balanced within an ounce-inch at the outer faces of the hub forging. Small aluminum washers are laid on the hubs until complete balance is obtained, and these washers are later fastened on stems within the hubs.

When the propellers leave this department,

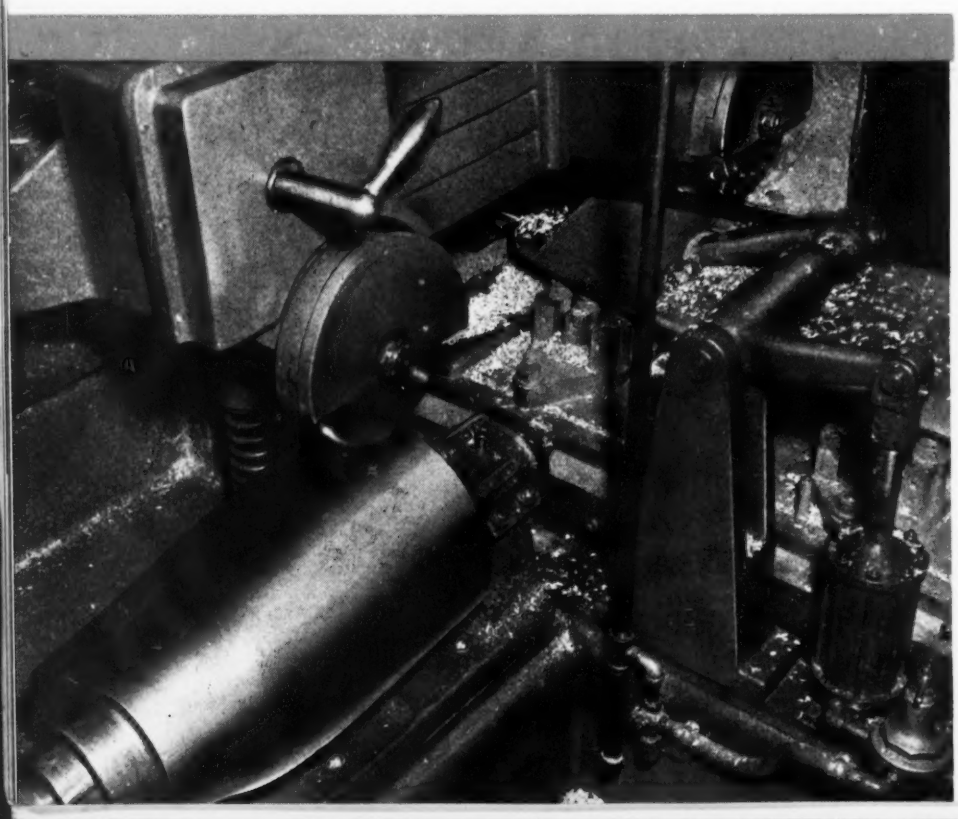


Fig. 13. Berliner Profiling Machine of Latest Design which Profiles the Aluminum Propeller Blades According to the Specified Camber

Fig. 14. Broaching Splines through the Cross-bore of a Four-socket Propeller Hub after the Bore has been Finish-machined

they go to a final "touch-up" conveyor along which there is a paint spray station for painting over any marks that have been made during balancing and final assembly. Here, also, is another battery of infra-red lamps for drying the touch-up paint. Then the propellers are disassembled, and all parts for one propeller are placed on trucks that are connected to an overhead chain conveyor which pulls them to the boxing conveyor.

In addition to the conveyors described, there is a slat type boxing conveyor and other power-driven conveyors for the governor, filter, brush housing, and relay assembly lines. A roller gravity conveyor is provided for the power-unit assembly operations. Practically all the power conveyors are equipped with Reeves variable-speed drives of 5:1 ratio.

Another feature of this plant, which saves a vast amount of time in the delivery of orders and requisitions about the plant, is a pneumatic tube system extending from the materials-control department in the main office building to all sections of the plant. A general view of the central station in the materials-control department is seen in Fig. 12. There are nine incoming and outgoing tubes.

Still another feature of this plant of especial interest to plant engineers is the equipment installed for breaking up all steel chips into short lengths, so that the greatest possible quantities can be loaded into gondola railroad cars for shipment to steel mills. The "pulverized" chips are blown into the cars through an overhead pneumatic conveyor. This chip-crushing equipment is installed at one end of the machine shop

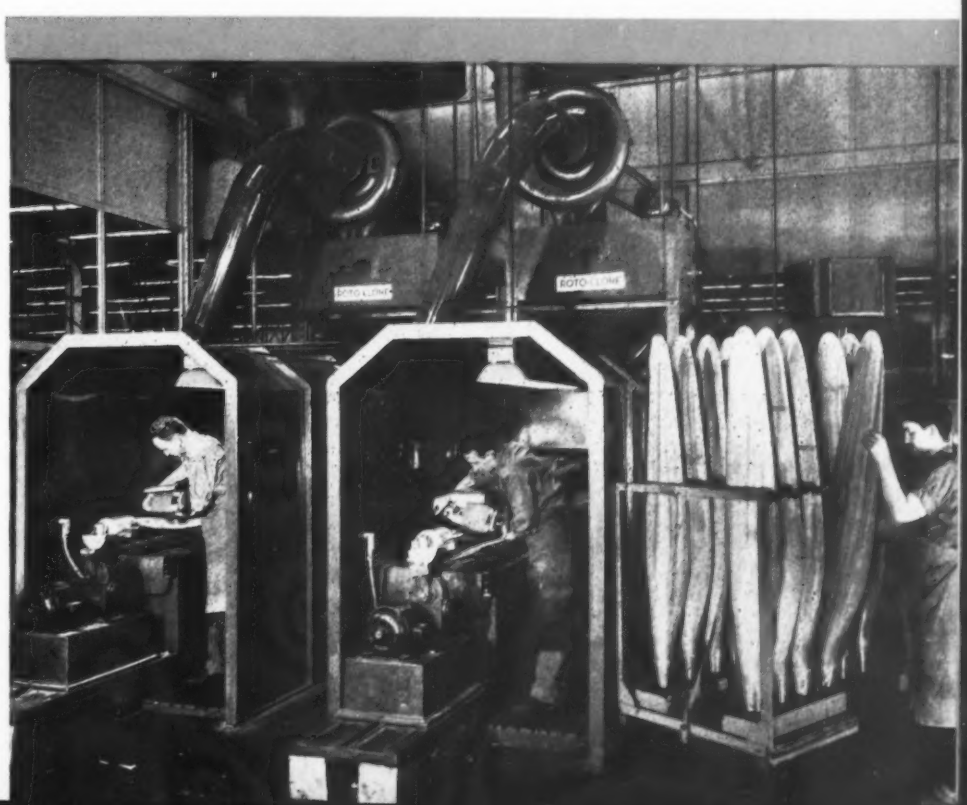


Fig. 15. Aluminum Propeller Blades are Polished by Emery-band Machines Installed in Booths Equipped with Dust-exhaust Systems

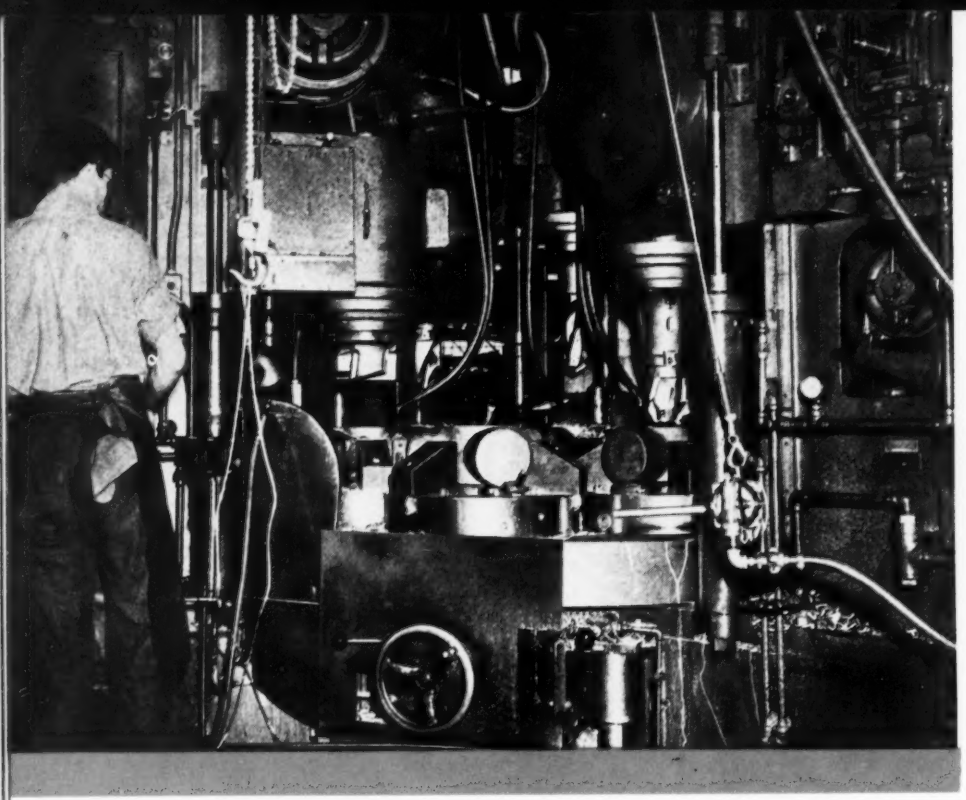


Fig. 16. Multiple-spindle Machine that Performs a Series of Facing, Drilling and Counterboring Operations on the Heavy Propeller Hub Forgings. Carbide Tools are Used

building on the first floor, and is fed by a chute that serves all five floors of the building. The higher-priced cutting oils are reclaimed from these chips, but not ordinary soluble oil.

This article would not be complete without calling attention to a few of the hundreds of machine shop operations performed in this plant on the latest types of machine tools. Fig. 13, for example, shows one of the latest types of machines built by the Engineering & Research Corporation for profiling aluminum propeller blades in the assembly building. At the left may be seen the drum cam and roller which control the up and down movements of the rotary cutter as it moves back and forth across the propeller blade, thus machining the blade to the required changing camber from the shank end to the tip. Cuts are taken on both the forward and return strokes of the cutter ram, as in conventional practice. The cutter used for this operation is equipped with sixteen tool bits, and is 9 inches in diameter.

Fig. 15 shows a view of two typical blade polishing booths, which are also located in the assembly building. Each booth is provided with an air exhaust system for collecting the abrasive dust. Polishing is accomplished through the use of abrasive belt units, which are moved by hand back and forth along the propeller blades as the blades are automatically swiveled by motor-driven units.

One of the most interesting machine tools in the machine shop is the huge five-unit Baker drilling and boring machine illustrated in Fig. 16, which performs the first operation on the large hub forgings. Incidentally, when the

Fig. 17. Cam Milling Machine Employed for Milling the Periphery of Fixed Ring Gears that have Sixteen Bolt Lugs

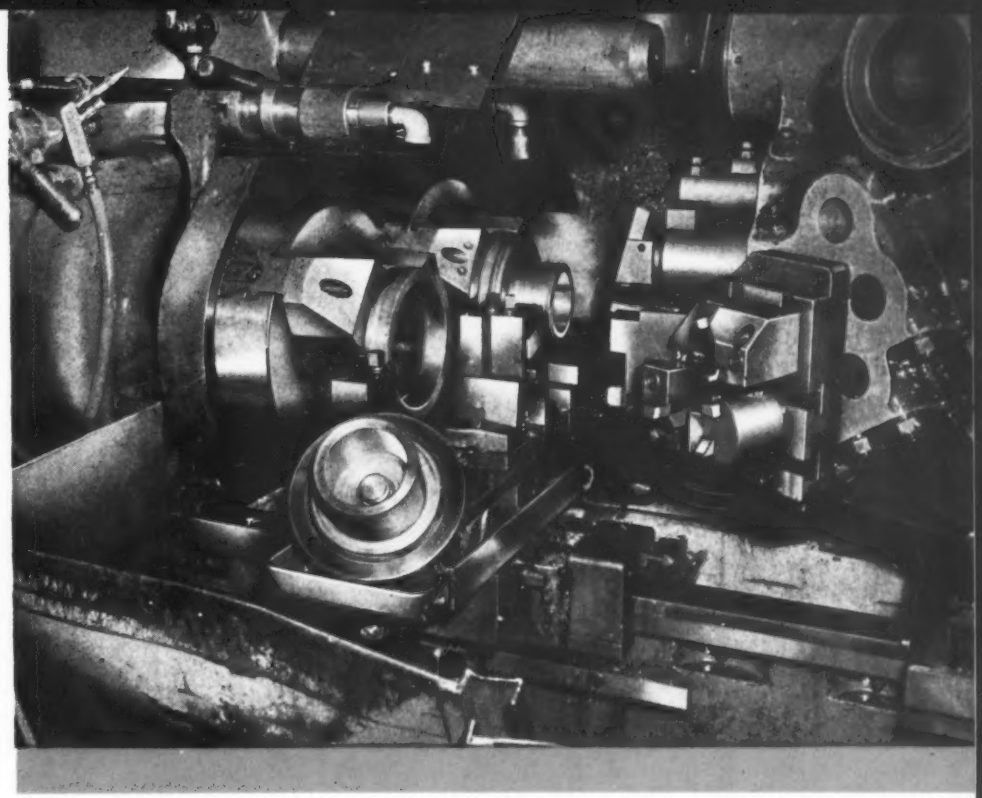


Fig. 18. Potter & Johnston Automatic of Duplex Design Tooled up for Simultaneously Machining the Front and Back Ends of Low-speed Bell Gears

four-bladed hubs reach this machine they weigh 450 pounds, and when they arrive at the assembly lines they have a weight of only about 70 pounds.

The middle station at the front of the Baker machine is used solely for loading and unloading. When a hub has been indexed to the second station, at the left, a spindle comes down and rough-faces the top side of the cross-bore hub with a cutter 9 inches in diameter, equipped with four inserted blades.

In the third station, a 3 5/16-inch diameter drill descends and drills through about 4 inches of solid metal to open up the cross-bore; in the fourth station, a two-step counterbore operates in the cross-bore; in the fifth station, another tool with four radial cutter blades cuts a counterbore; and in the sixth station, the counterbore is machined to a larger diameter with a head equipped with two cutters. All cutter blades used on this machine are carbide-tipped. Each spindle head is driven by an individual motor.

In Fig. 14 is shown a close-up view of a Lapointe broaching machine which cuts the splines through the cross-bore of the hubs. The broach is about 6 feet long, and has a maximum diameter of 4 inches. The back end of the heavy broach is supported by a carriage equipped with rollers that run on V-ways on opposite sides of the machine bed. There is also a carriage at a lower level which is provided with a screw jack, as seen in the illustration, for supporting the broach approximately midway between the end carriage and the faceplate of the machine. The hub is seated on a shoulder of the faceplate for locating purposes.

The Rowbottom cam milling machine shown in Fig. 17 mills the periphery of fixed ring gears which have sixteen bolt lugs. This operation is performed primarily for lightening purposes. The cut is taken by a small-diameter end-mill mounted on a head which is moved up and down as the work rotates. These up and down movements are controlled by the action of a roller attached to the cutter-head, which runs on a revolving cam of the same contour as the workpieces, but twice the size of the fixed ring gears.

One of a battery of Potter & Johnston automatics is shown in Fig. 18. This machine is of a two-spindle design, and is used in machining both sides of low-speed bell gears. One side of the gear is turned, faced, bored, reamed, etc., while the gear is mounted in the chuck at the front of the machine. Then the part is reversed and placed in the second chuck for performing similar operations on the opposite side. The six-sided turret is equipped with two sets of tools on each face to suit the operations that are performed simultaneously on the front and back of the gears as the turret faces are indexed into line with the headstock. The cuts are all roughing, and all the tools, with the exception of the reamer, are carbide-tipped.

Lycoming FOR

By P. E. GARLENT, Vice-President
The Aviation Corporation
Lycoming Division, Williamsport, Pa.

THE Lycoming R-680 series radial aircraft engines, extensively used in trainer planes today, have been in production for well over a decade. Back in 1930, the first tri-motor planes in regular transport service between New York and Washington were powered by Lycoming engines. From 1931 to the start of the present war, these engines were the only ones approved by the U. S. Army for use in primary training planes. Now large numbers of them are being installed in the Cessna AT-8, the Curtiss-Wright AT-9, the Beechcraft AT-10 (all twin-engine advance trainers), and the Stinson AT-19 navigation trainer, as well as in the standard Boeing PT-13 primary trainers.

The training of air cadets by the tens of thousands has resulted in a tremendous demand for trainer-plane engines. The Lycoming Division of the Aviation Corporation has greatly expanded its production of both radial and horizontally opposed engines to meet this demand. The radial model in current production has nine cylinders, and is rated at 265 to 300 H.P. Important factors in maintaining a steadily growing volume of production of this engine are the widespread use of new manufacturing equipment and the redesign of older machines for more efficient operation.

An interesting example of the effective use of new equipment is the arrangement for loading, centering, and grinding the engine cylinders, as shown in Fig. 1. A Heald centerless grinder is used in combination with a loading platform, a centering device, and a track connecting this centering device with the grinder.

In this illustration, a cylinder casting is shown inserted, cylinder end down, in a fixture which rests on the loading platform. The insertion of the casting in the fixture is made easier because

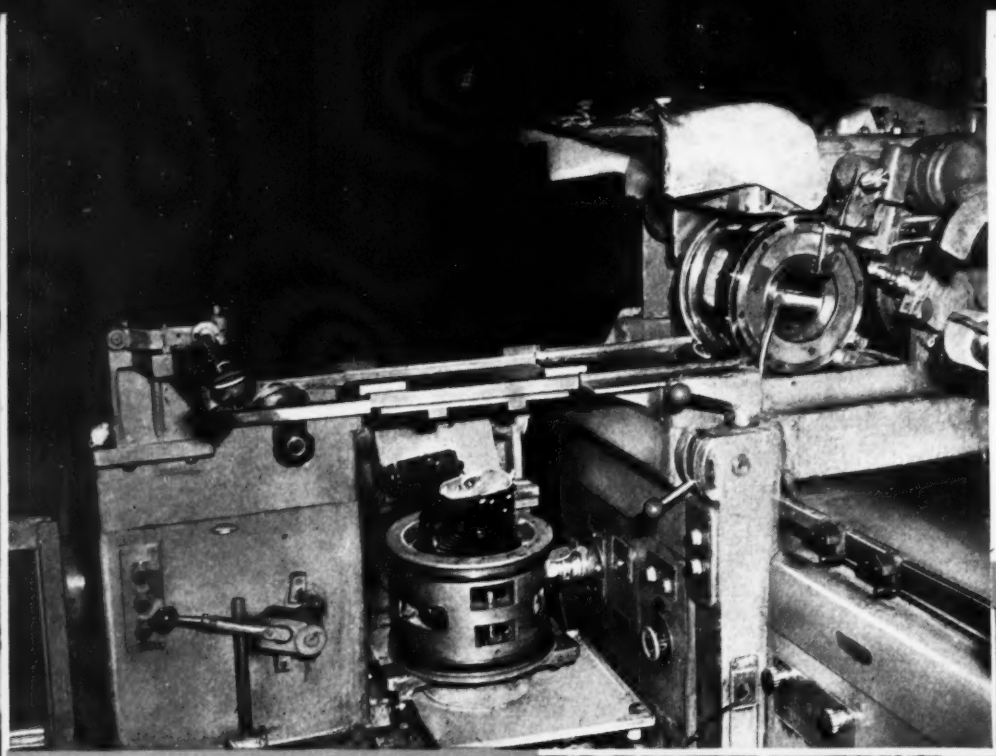
Radial Engines

TRAINER PLANES

the platform, in the loading position, is only a short distance above the floor level. When the cylinder casting is securely located in the fixture, the supporting platform is pivoted upward, so that the section of track which is in a vertical position directly back of the fixture assumes a horizontal position and replaces the movable section of track, shown above the fixture, which is swung out of the way. The cylinder casting and fixture, now resting horizontally on the track, are rolled to the left, where the fixture is revolved on rolls for the accurate centering of the interior cylinder wall with the two finished bearing surfaces around the outside of the fixture on which it revolves during the grinding operation.

After centering, the fixture and casting are rolled to the right and dropped into place against

Lycoming Radial Engines have a Record of Dependable Accomplishment Extending Back to Early Transport Days. Today Their Greatly Increased Output has Brought about Many Interesting Improvements in Manufacture, as Described Here



LYCOMING

Fig. 1. (Left) Loading and Centering Arrangement that Greatly Facilitates Accurate Placement of the Cylinder Casting in the Fixture for Internal Centerless Grinding

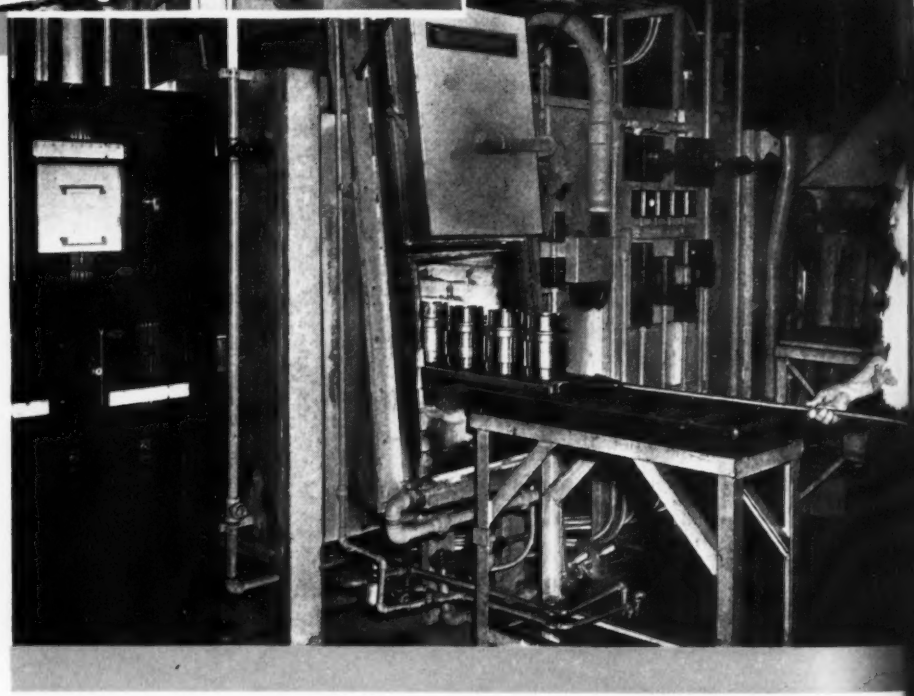


Fig. 2. (Right) Cylinder Barrels being Loaded into Pusher Type Heat-treating Furnace. The Heat-treated Work is Discharged from the Quenching Chamber that is Seen just Back of the Operator

the centerless grinder roll, where the grinding operation is completed. The cylinder is a chromium-molybdenum steel forging, and is ground to a tolerance of 0.0015 inch. Upon completion of the grinding, the fixture is rolled back to the center track section, where it is lowered to the unloading position.

The heat-treating of the cylinder barrels is conducted in a Westinghouse completely automatic, controlled-atmosphere, pusher type furnace (Fig. 2) to which is attached a quenching bath. Since this heating and quenching equipment is operated by only one man, who also washes the material before heat-treating, a definite advantage of the lay-out is that the loading and unloading stations are only 5 feet apart. This arrangement is made possible, even though the heating chamber of the furnace is 10 feet long, by the fact that the quenching chamber, instead of being attached to the end of the furnace, is set at right angles to it, while the loading station is also at right angles to the furnace heating chamber and on the same side as the quenching chamber.

The cycle of the push is controlled by automatic timing; and as soon as a carrier loaded

with parts is pushed out of the furnace chamber onto the table in the quenching chamber, it is dropped into the oil bath and is oscillated for the required period of time, which is also automatically controlled.

The atmosphere is generated by a Westinghouse gas generator, and is used to prevent scaling and decarburization. Other equipment in this heat-treating department is of the latest design, and includes a belt conveyor, a controlled-atmosphere furnace for hardening small parts; gas-carburizing, salt-bath, and nitriding furnaces; and tempering furnaces.

Close teamwork is required of the three men shown in Fig. 3, who perform over a dozen operations on each cylinder head in the short space of about seventy-six seconds. These operations include inserting bronze intake and exhaust valve seats, placing spark-plug bushings in position, securing a permanent seal at these places, screwing into place a molybdenum-steel forged cylinder barrel, inserting intake and exhaust valve guides, and driving steel rocker-arm bushings into place. To assure shrink fits, these parts are inserted as quickly as possible after the casting is heated in an electric oven for more

Fig. 3. (Left) These Three Men Must Work as a Highly Coordinated Team to Perform over a Dozen Operations before the Cylinder Casting, which is Heated to 650 Degrees F., Becomes Too Cool

Fig. 4. (Right) Ingenious Floating Support for the Cylinder Casting Enables Accurate Reaming of Valve Guides to be Accomplished without Difficulty

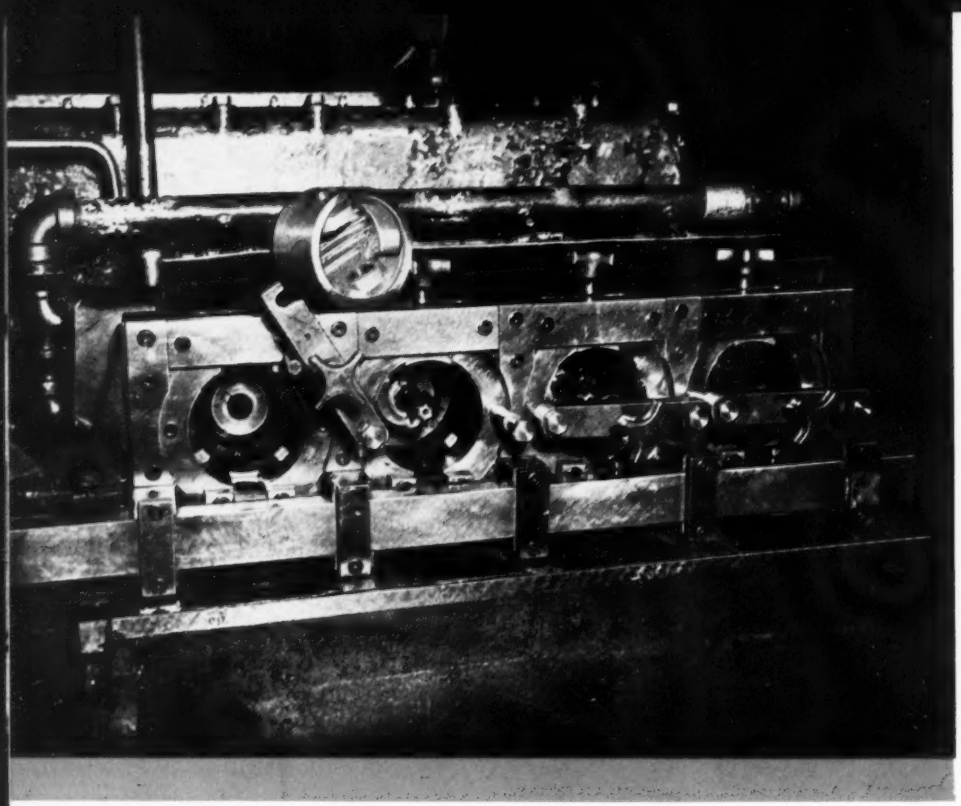


Fig. 5. This Horizontal Milling Machine was Rebuilt to Mill out Two Recesses in the Inner Wall of the Pistons. Four Pistons are Milled by the Machine Illustrated in One Completely Automatic Operation

than two and one-half hours to a temperature of over 650 degrees F.

A machining operation on the cylinder heads that had proved extremely difficult to perform accurately was finally simplified by the use of an ingenious holding device. This operation is the reaming of extruded aluminum-bronze valve guides, as shown in Fig. 4. It is performed on a Natco single-spindle boring machine.

Previous attempts to ream the valve guides with the cylinder casting mounted on a rigid holding fixture had not been successful, owing to the fact that a slight distortion frequently occurred after the valve guide had been inserted in the cylinder and the heated cylinder casting had cooled.

A full floating support for the casting provided a solution to the problem, and enabled a tolerance of 0.001 inch to be met without difficulty. As shown in the illustration, the cylinder casting is clamped to a ring which is free to slide back and forth on a plate with a flat upper face and a slightly convex lower face. The convex lower face is seated in the concave surface of the pedestal, and has a limited range of movement. This arrangement permits the valve guide to locate itself horizontally and vertically as the reamer is inserted, and yet provides a firm sup-

Fig. 6. Two Rows of Cam Lobes and a Narrow Separating Concentric Surface are Milled on This Cam Ring in One Operation

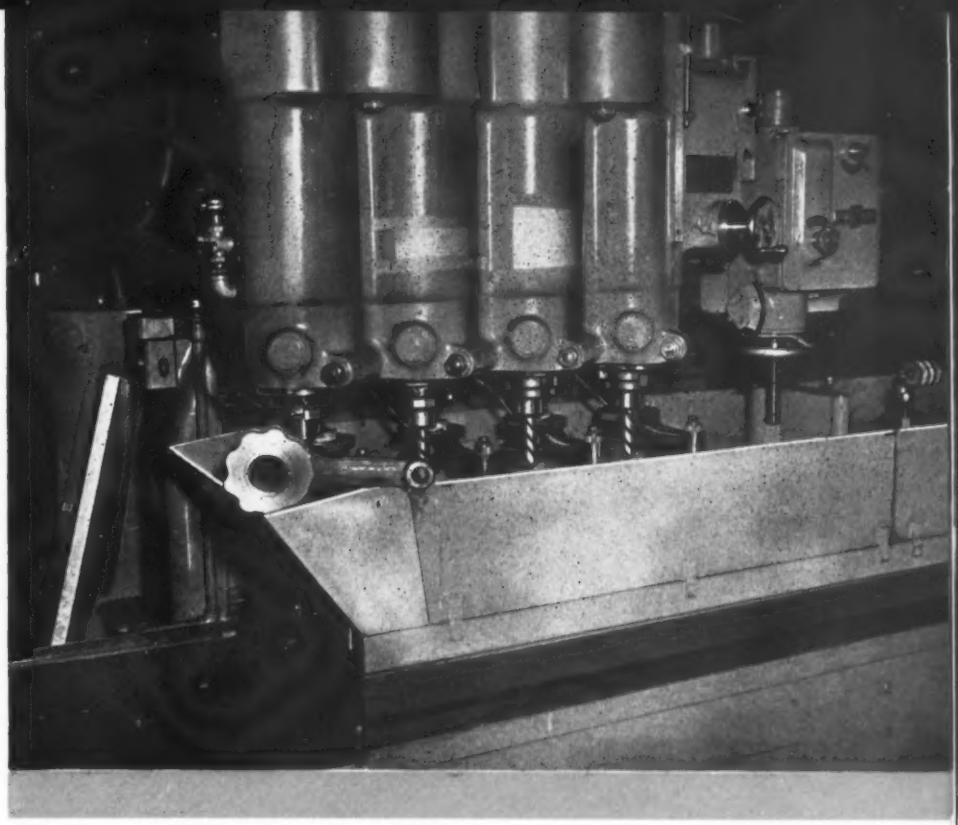


Fig. 7. Milling Cam Outlines on Four Master-rod Forgings at One Time. Another Set of Fixtures at Right-hand End of Table Permits Loading and Unloading of Additional Work while Machine is in Operation

port for the casting while the reaming operation is being performed.

An excellent example of how old equipment can often be rebuilt to perform efficiently operations for which it was not originally designed is shown in Fig. 5. This is a four-spindle Ingersoll horizontal milling machine originally employed for work on automobile-engine parts. The machine is now being used for milling a lightening recess in the interior wall of the piston at each side between the pin bosses.

Loading is done while the fixture is in its central position, a piston being inserted in each of the four cylindrical openings and clamped in place. In operation, the entire work-supporting fixture is automatically traversed to one side, causing the four cutters to enter the work. When the cutters reach the required depth, the four pistons are rotated to the right and left through an arc to complete the cuts. The fixture is then traversed in the other direction and the cuts are repeated on the opposite sides of the four pistons, after which the fixture returns to the starting position for unloading. The entire cycle is automatic.

The fixture slides along the ways formerly used to support the machine table. A drum with cam tracks not only traverses the fixture longi-

Fig. 8. Grinding Inner Faces of Master Rod. The Surface to be Ground is Rotated beneath a Small Belt-driven Grinding Wheel

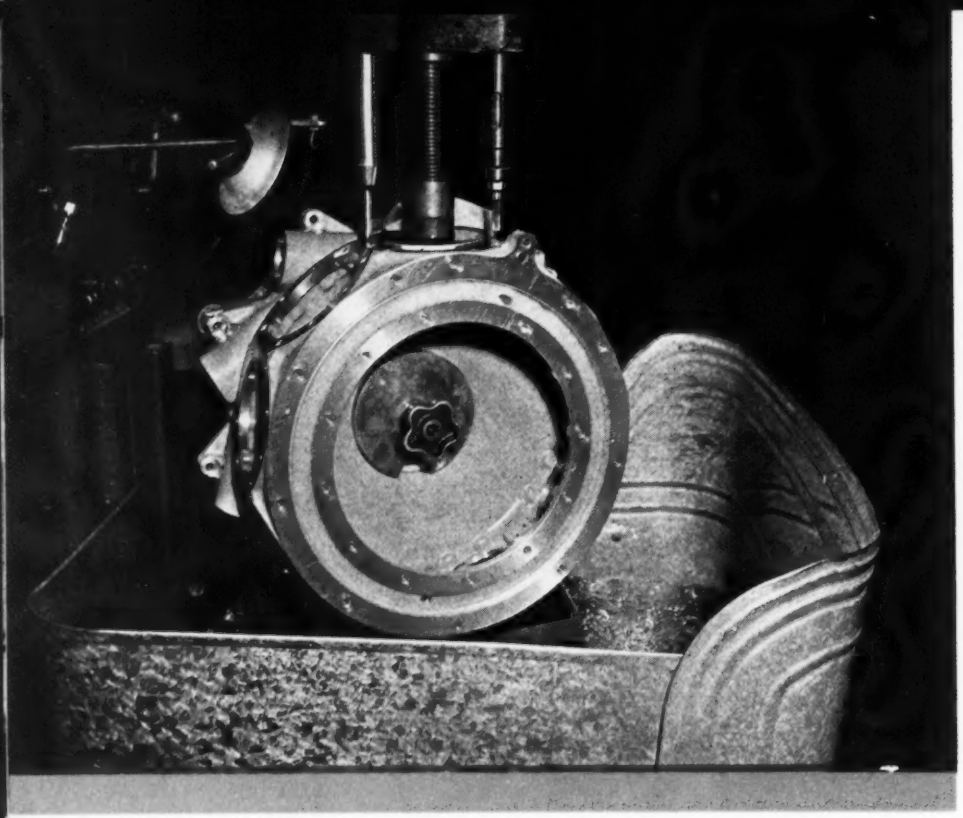


Fig. 9. Tapping Stud Holes around Cylinder Pad. Guide Pin at Left Insures Correct Horizontal Location of Tap, while Disk Inserted in Cylinder Opening Provides Vertical and Concentric Alignment

tudinally, but also rotates the piston-holders through the required arc. There are two cam-slots and two roller followers. Each follower is attached to a bar parallel with the drum axis and arranged to slide in guides above the drum. The rear bar moves the fixture along the machine ways. The other bar carries cross-head blocks which engage the cylinder-holders and cause them to swing in an arc, first to the right and then to the left.

Another ingenious arrangement is shown in Fig. 6, where a Van Norman cam milling machine is set up to cut the entire outline of the valve-actuating cam ring in one operation. This ring has two rows of four cam lobes each, which operate the exhaust and intake valves through push-rods and rocker arms. As is clearly shown in the illustration, these cam lobes are located in alternate positions around the ring. What makes the cutting of the complete cam outline in one operation somewhat complicated is that the two rows of cam lobes are separated by a narrow surface that is concentric with the axis of the ring at all points.

Two cutters are employed. One mills one set of cam lobes and that part of the cam ring between the lobes, including the separating concentric surface; and the other mills the second

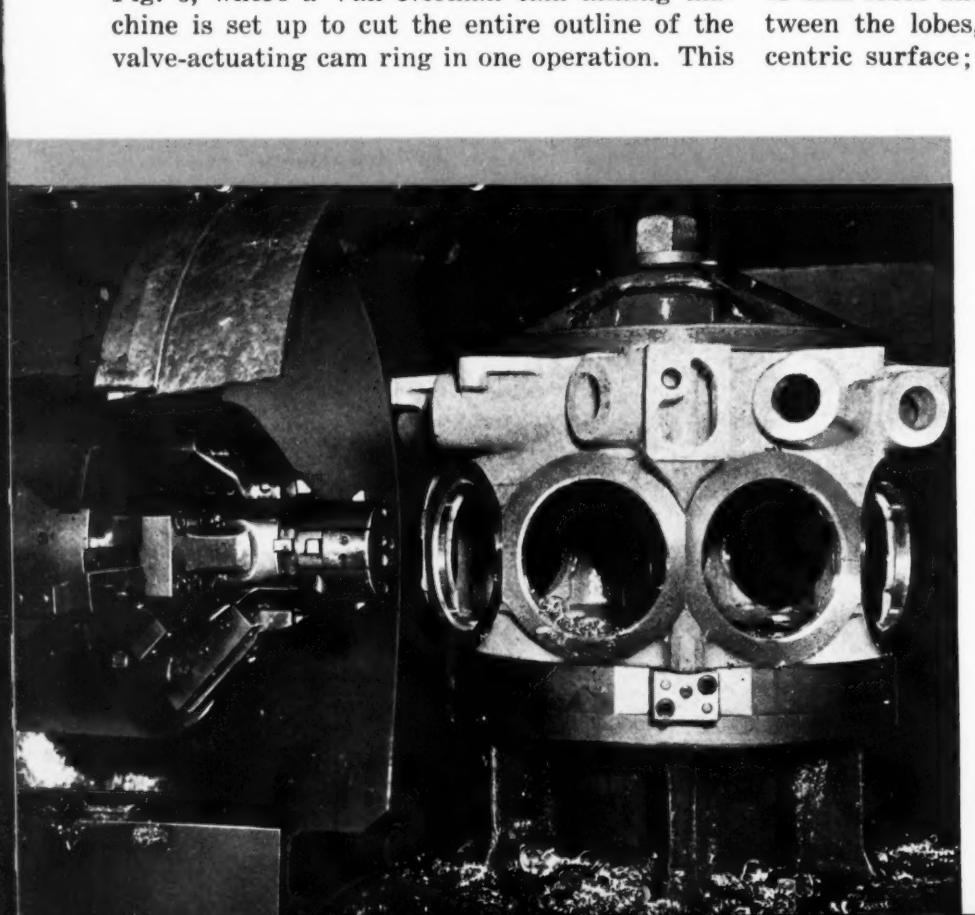


Fig. 10. Boring and Chamfering the Cylinder Openings of Crankcase, and Facing Pads, Using One Head with Seven Cutting Tools

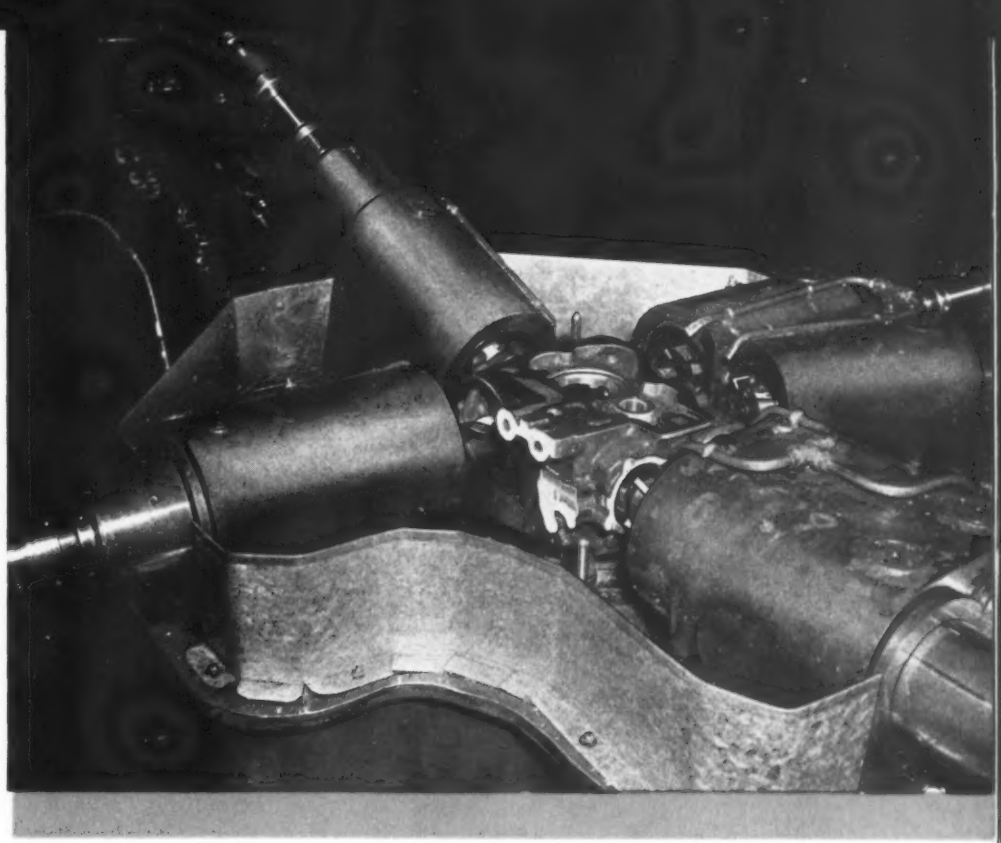


Fig. 11. Tooling Employed in Performing Multiple Drilling, Boring, Facing and Chamfering Operations on Accessory Drive Housing. A Six-spindle Horizontal Boring Machine is Used for This Work

set of cam lobes and that part of the cam ring between these lobes, including the adjoining concentric surface. In fact, one-half of the circumference of the separating surface between the two sets of lobes is milled in four sections by one cutter, and the remainder of its circumference is milled in a similar manner by the other cutter.

Another cam-milling operation is shown in Fig. 7. Here a Cincinnati milling machine is being used to cut the outlines on four chromium-nickel-steel master-rod forgings at one time. First a roughing cut is taken around the entire outline, and then a finishing cut of about 0.001 inch is taken. At the opposite end of the table, a duplicate set of work-holding fixtures is provided, so that loading and unloading can proceed while the operation is in progress.

The inside faces of the master rod are ground to provide link-rod clearance. The arrangement shown in Fig. 8, in which a belt-driven 0.72-inch radius grinding wheel is utilized, was developed by one of the Lycoming employes. The master rod is rotated back and forth by hand on the supporting spindle, so that the inside face is traversed across the grinding wheel.

In Fig. 9 is shown the tapping of stud holes around the aluminum-alloy crankcase cylinder pads on a Leland-Gifford single-spindle machine. A Class 4 fit is required. Vertical and concentric alignment is effected by means of a large circular disk which is set down into the cylinder opening, while the correct alignment around the circular pad is provided by a pin which is fitted into the hole diametrically opposite the one being tapped.

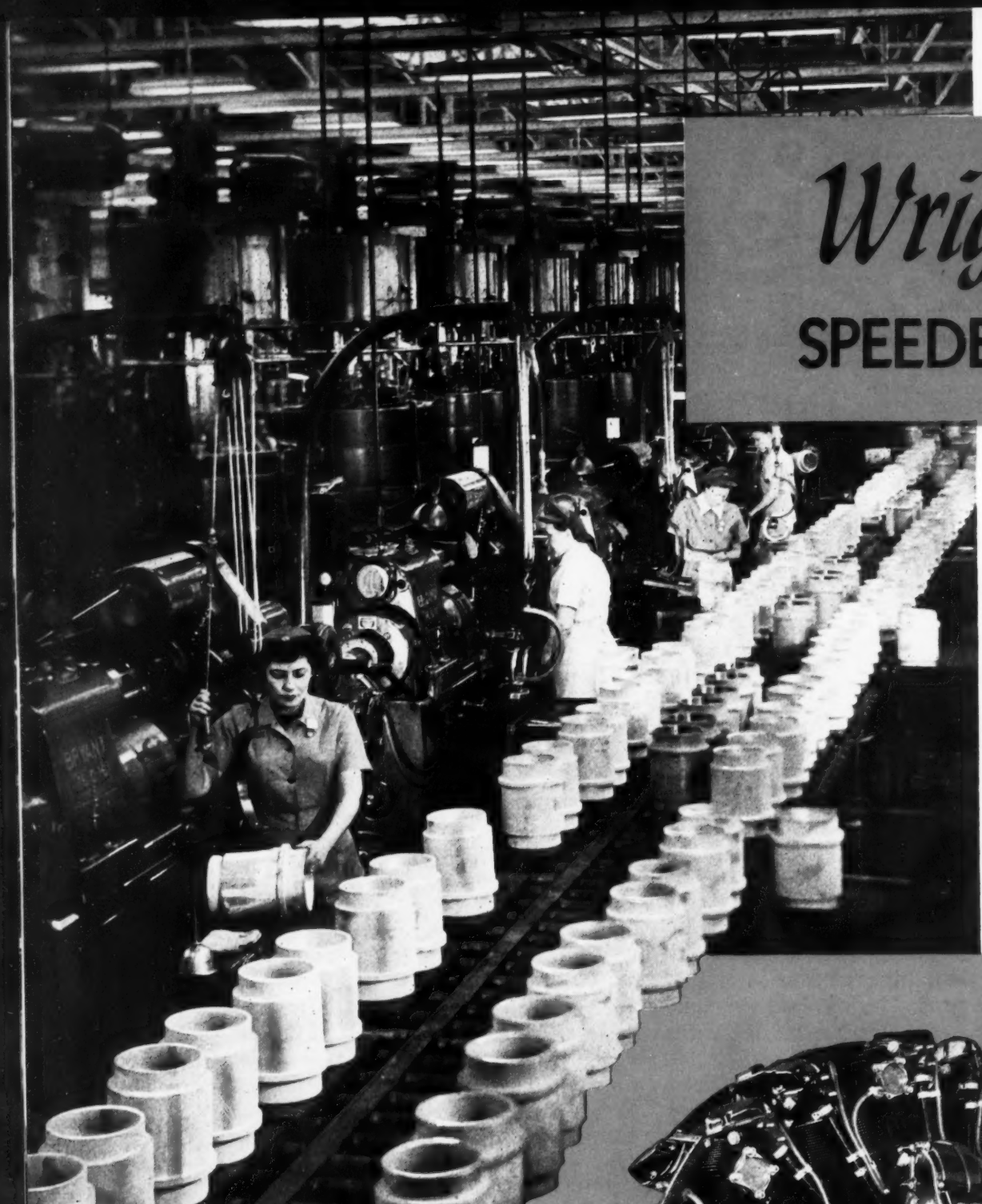
The cylinder openings of the crankcase are bored and chamfered and the pads are faced on a Foster Fastermatic, as shown in Fig. 10. The single tool-head carries rough- and finish-facing tools; rough-, semi-finish-, and finish-boring tools; and rough- and finish-chamfering tools.

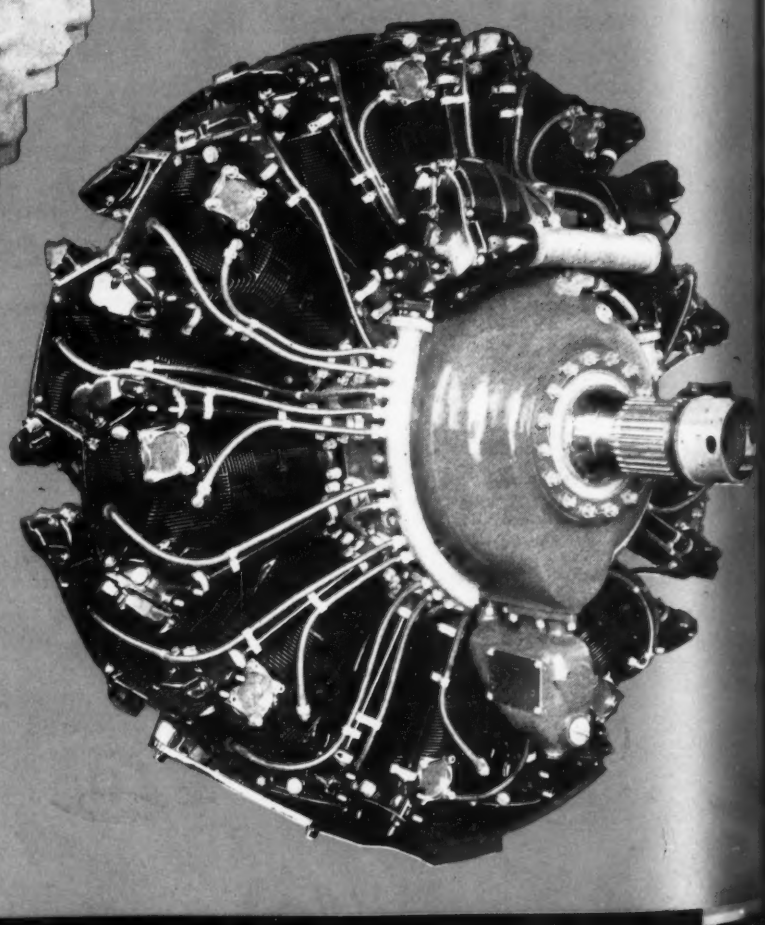
Fig. 11 shows several operations being performed on the accessory drive housing in a W. F. & John Barnes horizontal boring machine. The single head at the rear, which is set at an angle, finish-bores and finish-faces the magneto pad, using three tools. The facing tool has three blades, the first of which takes a roughing cut, the second a semi-finishing cut, and the third a finishing cut.

The single head at the left drills a hole 0.9375 inch in diameter and faces and bores the shoulder of the left distributor mounting hole.

The left head of the front pair faces and bores the oil-pump opening, using four boring and four facing blades. The right-hand head of the front pair bores and chamfers the carburetor opening. The right-hand head of the side pair bores and chamfers the fuel-pump opening, using four boring blades. The left-hand head of the side pair bores and faces the right-hand distributor opening, using two boring and four facing blades.

Wright SPEEDED UP





Shortage of Man-power has Led to the Employment of Thousands of Women Workers in Wright Aero Plants and the Installation of Mechanical Lifting and Handling Devices, as well as Conveyors of Various Types

Cyclone Production
BY SPECIAL METHODS

By P. W. BROWN, Assistant Works Manager
Wright Aeronautical Corporation

THE Allied successes of the last twelve months have demonstrated beyond question that final victory hinges upon air power, and in consequence, the demands for aircraft engines have been multiplied to an almost fantastic degree. To meet these demands, not only in quantity, but also in time, has necessitated the application by the Wright Aeronautical Corporation of manufacturing methods designed to produce more engines per man, per machine, and per hour than ever before.

Even with these new machines and methods, considerable plant expansion has been necessary, involving a tremendous increase in the size of the existing midwestern plant where two new machine shops, a magnesium foundry, and an aluminum foundry were constructed, and the erection of a huge, new, single-story, air-conditioned, windowless factory in the vicinity of Paterson, N. J. This new plant was constructed on a revolutionary new principle known as "Warspeed," whereby the concrete roof and supports were the first parts built, the walls and floor being added later. Mobile wooden forms for concrete, mounted on rails, were raised to the proper height by hydraulic jacks, and the first bay poured. After the concrete had set, the forms were lowered and hauled into position for pouring the next bay, whereupon work was immediately started on the floors and walls. By this means, the plant was in actual operation in about four months from the time ground was broken, and it is estimated that fully two months of construction time were saved.

As in other industries, the shortage of manpower has led to the employment of thousands of women workers which, in turn, has necessitated the installation of mechanical lifting and handling devices. These, in combination with conveyors of various types, have greatly reduced the handling time at machines and maintained a steady flow of materials through the shops.

Mechanization has spread to the foundry clean-up benches, where the flash and minor surface irregularities are now removed from cylinder heads by machines rather than by the use of hand-operated, high-speed, pneumatic rotary files. These machines were designed by Wright engineers, and built by the Ireland Machine & Foundry Co. As shown in Fig. 1, they are equipped with a 12-inch abrasive wheel, 1/8 inch thick, which is mounted on a swinging shaft and operated by a 5-H.P. motor at a speed of 9000 feet per minute. The grinding wheel is swung up and down to suit the contour of the cylinder head, as the work makes half revolutions about the horizontal axis, under the control of a disk-like follower that runs on a built-up master cam at the left end of the machine. Each section of the cam corresponds to one of the spaces between the twenty-six fins on the top of the head. The cam is mounted on the fixture that holds the work-piece, and is rotated by a separate small motor. Indexing is automatic.

One of the chief difficulties in designing this machine was the fact that the fins are slightly thickened at the parting line to allow for misalignment, thus causing a reduction in the width of the grooves at this point. Furthermore, there is a tendency for the flash to bridge over at the seam, forming a solid rib of metal which must be cut through. This difficulty has been over-

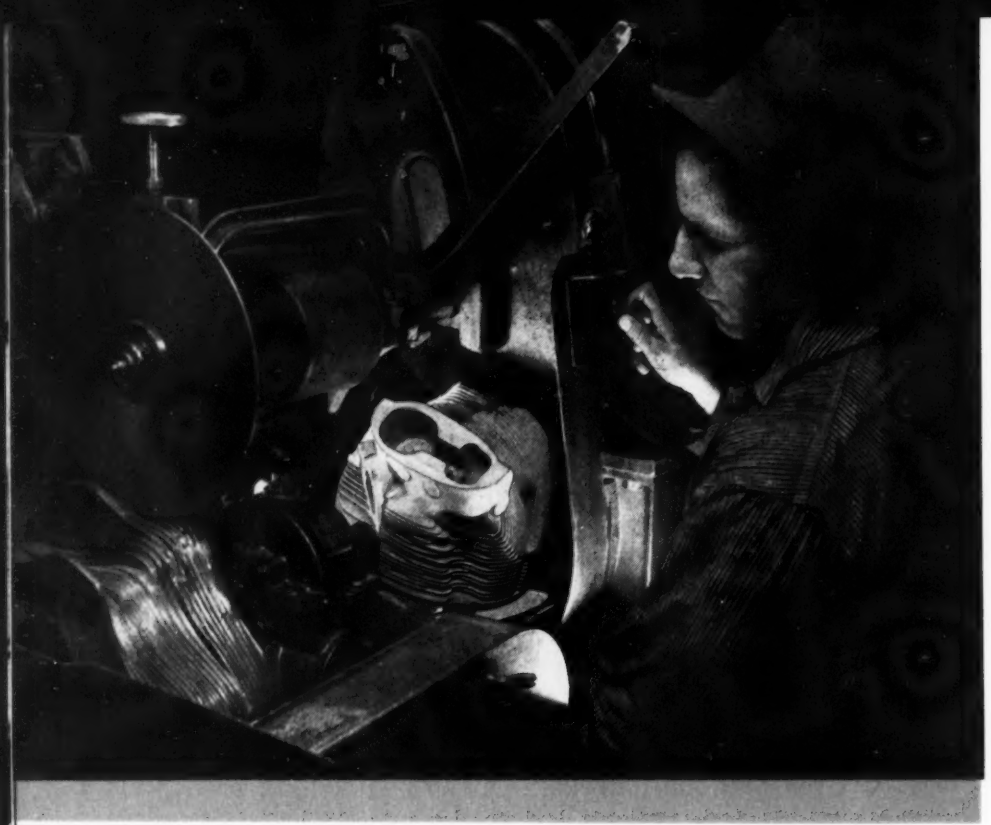


Fig. 1. Removing the Flash between the Fins of a Cylinder Head on Machine Equipped with a Master Cam that Controls the Path of the Grinding Wheel between Each Two Fins

come by incorporating an automatic clutch in the fixture-rotating drive which changes the speed from 20 to 5 R.P.M. as the wheel approaches the thickened portion, and then accelerates it again for the remainder of the cut.

A similar machine is used for cleaning the twenty-six fins on the circumference of the cylinder body, and in both cases, provision is made to compensate for wheel wear. The fins are 0.063 inch thick at the tips, taper to 0.095 inch at the root, and vary in depth from 3/4 inch to 3 1/4 inches. The space between the fins is 0.156 inch at the tip, and 0.124 inch at the root. Some manual cleaning must still be done on small areas, but the total fin-cleaning time has been reduced to one-third of that formerly required.

On the machining line the most outstanding example of high-production equipment is a new Greenlee automatic transfer machine used in the manufacture of cylinder heads. Similar to the machine described in July, 1942, MACHINERY, this new machine has a length of over 200 feet, and performs more than 70 per cent of all the machining operations required on the heads. It is built in three main sections, connected by a short roller conveyor, each of which is independently controlled. The parts are loaded on forged steel locating plates, and after passing

Fig. 2. Wright Forged Cylinder Head before and after Machining, the Deep Narrow Fins being Milled One at a Time at Speeds Almost Equal to Those Used in Woodworking

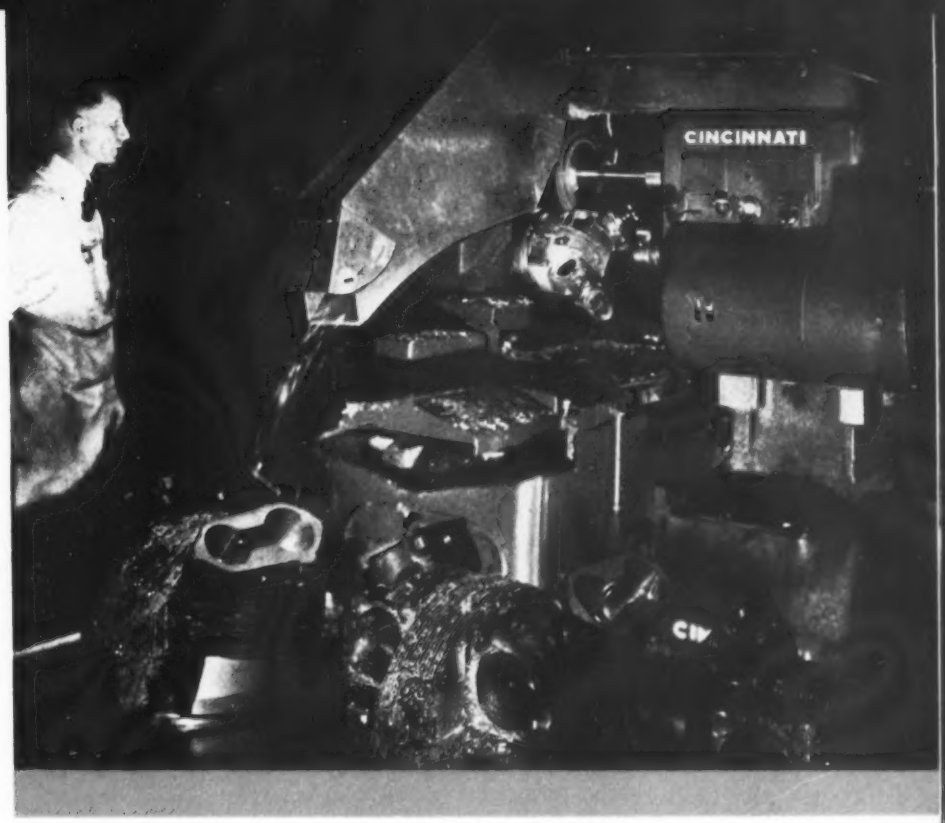


Fig. 3. (Right) Milling the Fins around the Body of a Forged Cylinder Head on a Machine Equipped with Two Narrow Milling Cutters that Cut Two Grooves at One Time

Fig. 4. (Below) Milling the Fins on Dome of Forged Cylinder Heads on Two-spindle Machine under the Control of a Built-up Master Cam at the Right, which has Separate Forms for Each Fin Groove

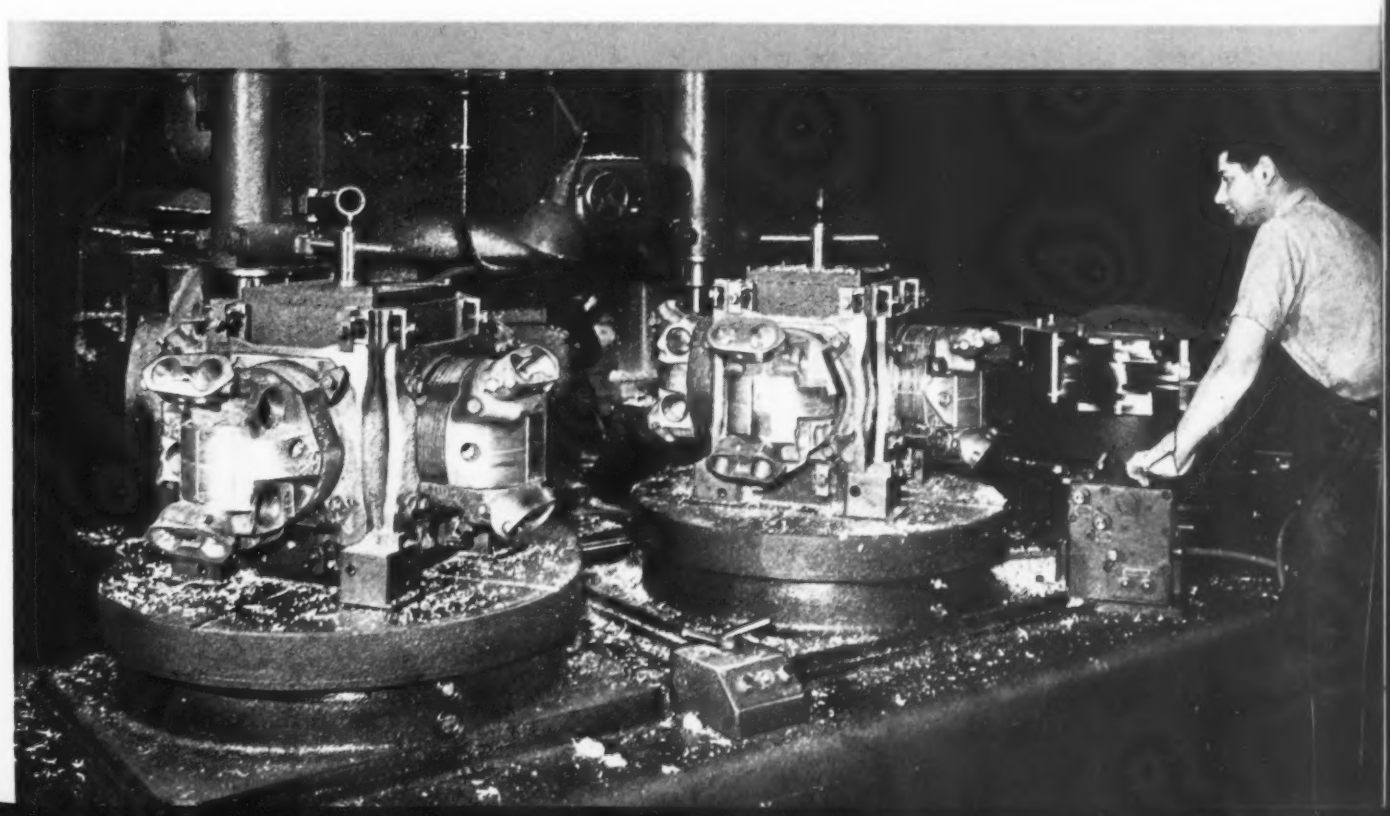
through the first section, where operations are performed on the right- and left-hand sides, they are picked up by a hydraulically operated arm and inverted to drain out the excess oil.

The cylinder heads are then returned to the conveyor for passage through the second section, where operations are performed on the front and rear sides. A turntable installed in the conveyor permits the parts to be turned 90 degrees before loading into this section.

Leaving the second section, the parts are again drained before advancing to the third section. Since the operations of reaming the valve guides and counterboring the valve-seat recesses must be performed from the inside of the head, the parts are turned over in a hand-operated cage before entering the third section.

Upon emerging, the parts are again turned right side up, and are then passed through an automatic washing machine before proceeding over a roller conveyor to the final operations. In addition to all the drilling, reaming, countersinking, and tapping operations, this giant machine performs a routing and several milling operations.

One of the most important contributions to the aircraft-engine industry has been the development by the Wright Aeronautical Corporation



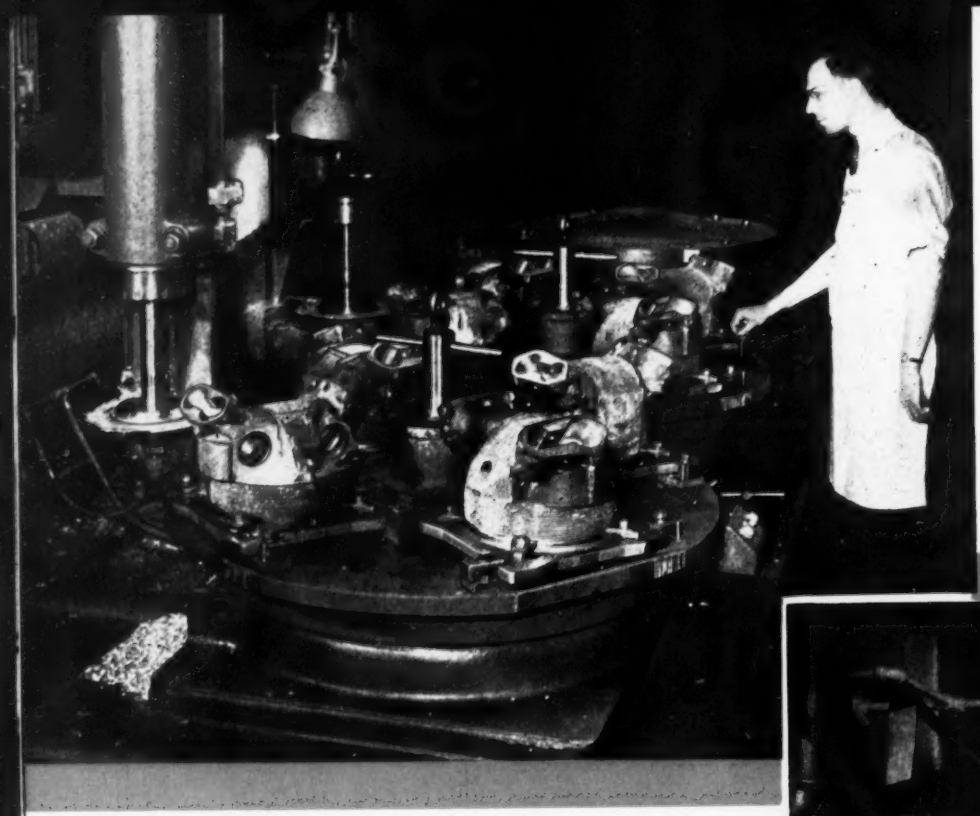


Fig. 5. (Left) Double-spindle Hydro-tel Milling Machine Set up for Milling Fins adjacent to the Exhaust Port on the Forged Cylinder Heads

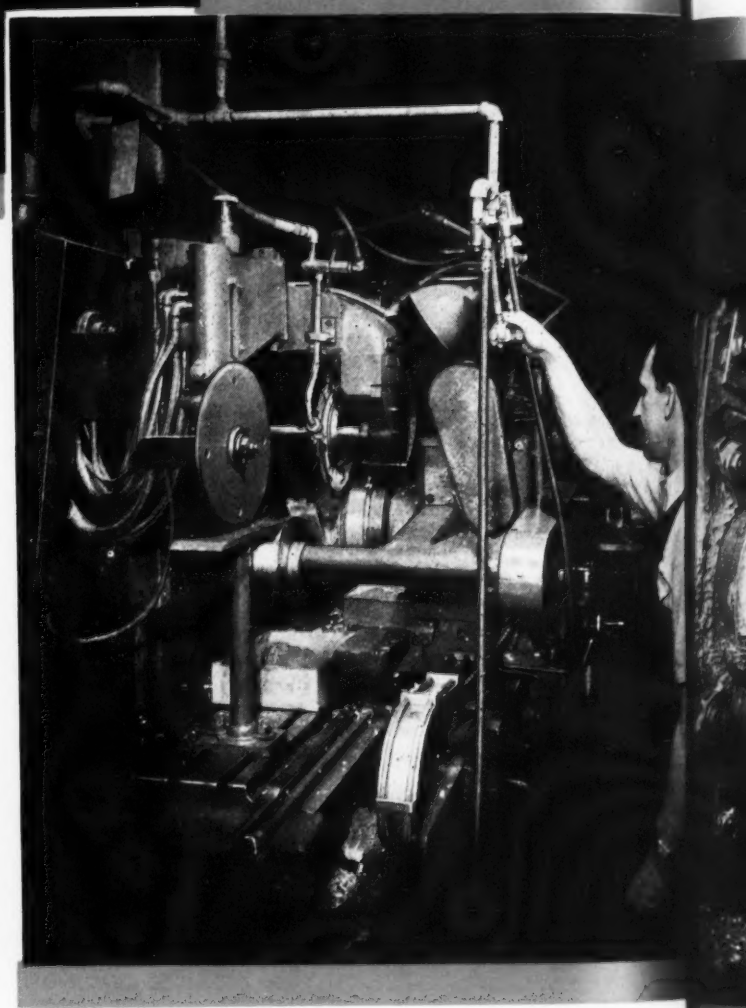


Fig. 6. (Right) Close-up View of Machine in Fig. 3, Showing Arrangement of Two Slitting Cutters, and Cam and Follower that Control the Up and Down Movements

of a forged aluminum-alloy cylinder head, the use of which has been found to increase the horsepower output of engines by as much as 12 per cent. One of the rough forged heads is seen at the right in Fig. 2, while a machined head is shown at the left.

The manufacture of this head presented unusual machining problems, chief among which was the cutting of the fins. The spacing between fins is 0.112 inch, and their thickness is only from 0.052 to 0.068 inch. The fins are divided into three main groups. The first group contains fifteen spaces, approximately 1 1/2 inches deep, which run around the lower part of the body; the second group contains twenty-eight spaces of varying depths and contours that run across the curved upper surface of the head; while the third group consists of sixteen spaces of varying depth and irregular root contour which partially surround the exhaust port. The maximum depth of cut is about 2 3/4 inches.

The circumferential fins on the lower part of the body are cut on Cincinnati Hydromatic milling machines set up as shown in Fig. 3. The part is held on a power-driven rotary fixture in a horizontal position, and is located by a dowel that engages a previously reamed hole. A master cam which rotates at the same speed as the part produces an up and down movement of the cutter-arbor to form the required root contour. The disk-like cam follower, seen in Fig. 6, rolls along a flat plate as the cutters are fed to the work, and then rides on an elliptical shaped drum cam during the actual cutting.

Two cutters are used, each 0.112 inch thick and spaced at the mean thickness of the fins.

The cutters are 13 inches in diameter and are provided with nine carbide-tipped teeth. The cutting speed is approximately 4500 surface feet a minute, and the feed 70 inches a minute.

The fins on the dome are milled by Cincinnati Hydro-tel machines of special design. These machines are built with two spindles that carry single saws of the same size as those used on the Hydromatics. The saws are run at the same speed as those on the Hydromatics. Opposite each spindle is a rotary table (as seen in Fig. 4) carrying a square fixture on which four cylinder heads are mounted. A third table at the right, carries four multiple-step cams that control the form of each fin by imparting horizontal movements to the milling heads.

A table feed of 70 inches a minute is employed during the cutting operation, but this is increased to 250 feet a minute for indexing the work-fixture. During the fourth indexing, however, the speed is slowed somewhat to allow time for the cam follower to index to the next step on the cam. A close-up view of one of the cutters in action is seen in Fig. 7.

The fins on the side of the exhaust port are also milled on Cincinnati Hydro-tels of the same type as those used for the top fins, the only difference being that the four heads are mounted on each table in an upright position and box fixtures are not required. One of these machines is shown in Figs. 5 and 8.

The cutting of the thin, deep fins on the forged cylinder heads introduced some unusual conditions. For example, special attention had to be paid to the design of a cutter operated at such high cutting speeds, in order to avoid the range

Fig. 7. (Left) Close-up View of One of the Cutter-spindles on Machine in Fig. 4, which Mills the Fins on the Dome of the Forged Cylinder Heads

Fig. 8. (Right) Close-up View of a Machine Similar to that in Fig. 5, which Shows the Method of Holding the Work-pieces in Milling the Fins adjacent to the Exhaust Port

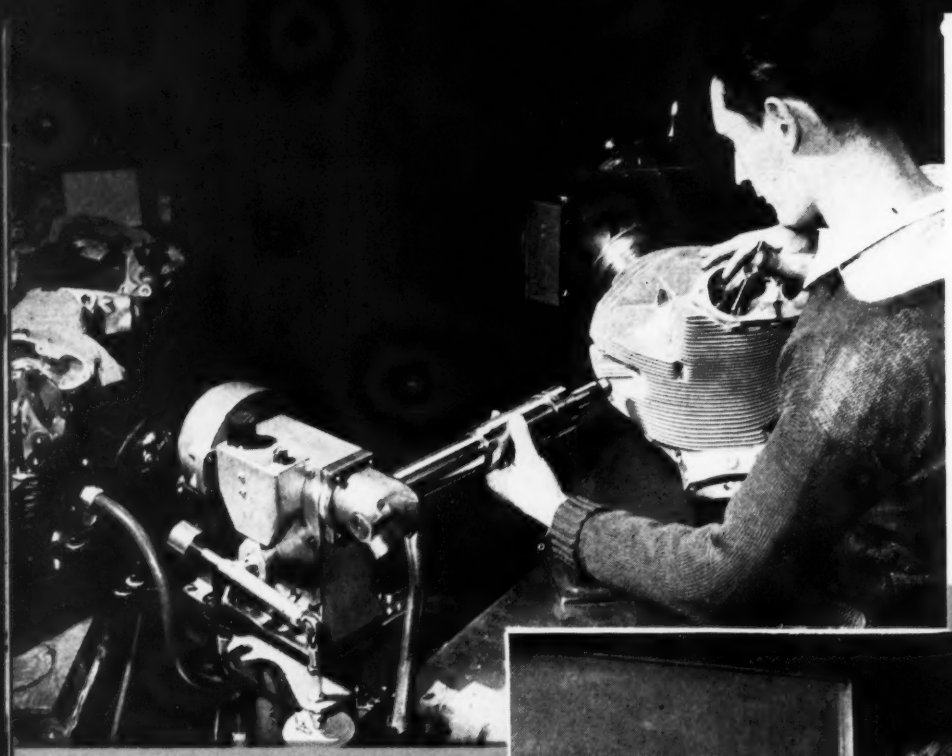


Fig.9.(Left) Assembling Spark-plug Bushings into Cylinder Head by Means of Special Machine that Insures Proper Torque

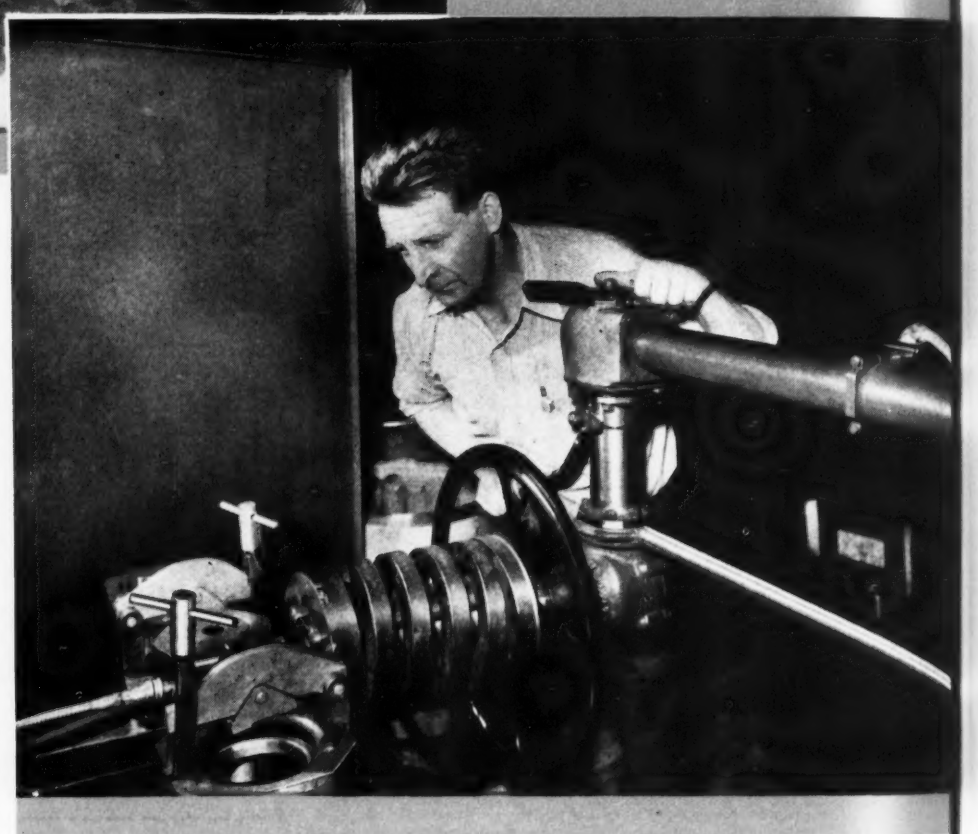


Fig. 10. (Right) Special Equipment Designed for Burnishing the Thread in the Split Crankshaft Cheeks to Facilitate Assembly of the Cheeks to the Crankpins

of critical harmonic frequencies of the tool and work. Furthermore, it was found that such operations should be performed dry. The use of cutting fluids of any kind proved to be impractical, because the centrifugal force throws off all coolant. Moreover, coolants tend to set up an abrasive action that is harmful to tool life.

With properly designed cutters, carefully sharpened and honed to a fine finish, the heat generated by the cutting action is virtually negligible, and the work remains cool enough to be handled without any difficulty. As some lubrication is desirable, however, tallow is fed directly to the teeth of the saws by an automatically operated pressure gun. The saw teeth pass through a slot in the end of the gun nozzle. Such a nozzle is seen at the right in Fig. 7.

After the heads have been assembled to the cylinder barrels, threaded bronze bushings are inserted in the spark-plug holes. To assure a gas-tight fit, these bushings must be screwed down to seat firmly into a countersunk recess in the head. However, the pressure applied must not be so great as to damage either the

threads in the aluminum head or those into which the spark plug is screwed. This operation is satisfactorily accomplished through the use of a special Scandia machine, designed to drive at a predetermined torque.

The cylinder assembly is mounted on a fixture, as seen in Fig. 9, being located by a hardened and ground pin, which passes through one of the valve guides and fits into a bushing in the fixture. The driving arm is operated by an electric motor through a clutch, set to disengage at the proper torque. A sleeve, free to slide on the driving arm, terminates in a threaded adapter to which the bronze bushing is screwed.

In an operation, a bushing is screwed on the adapter with the flange bearing against a stop-collar, and the sleeve is advanced by hand until the bushing starts into the hole. A handle at the front of the machine is then raised, causing the driving speed to increase to 100 R.P.M. and spinning the bushing down to within a few threads of the bottom of the hole. Lowering the handle reduces the speed to the normal 30 R.P.M., and the bushing is driven firmly on its seat until the proper torque has been reached, when the clutch disengages and the drive stops.

The driving mechanism is so designed that when the motor is reversed, the stop disengages slightly before the adapter begins to unscrew, thus preventing any possibility of the bushing backing out during the withdrawal. Should maximum torque be reached before the bushing is seated, a signal light flashes to warn the operator. Similarly, if the bushing goes in too easily and seats before the proper torque is applied, warning is given.

To permit the use of the single-piece master rod, the crankshafts of Wright engines are made in two parts or, in the case of double-row engines, in three parts. The crankshaft cheeks are split, and are locked to the crankpins by means of cap-screws passing through lugs on each side of the split. To insure the necessary tightness, these screws, which may be either 1 1/8 or 1 1/2 inches in diameter, according to the model of the engine, must be pulled up until they have stretched 0.009 inch.

Under this heavy loading, there is a tendency for the threads to seize and tear, even when the male member is carefully ground and polished. Burnishing the internal thread by ordinary methods is unsatisfactory, since this must naturally be done with the lugs in the open position. When the bolt is tightened, however, the lugs are pulled together around the circumference of a circle, causing a slight distortion.

This difficulty has been overcome by the use of a new type of Scandia machine, shown in Fig. 10, which performs the burnishing with the lugs held under the same tension as in service. The part is placed in a fixture on the bed of the machine, and clamped lightly with one face of the lug against a stop. A dummy crankpin is then inserted in the crankpin hole. The threaded

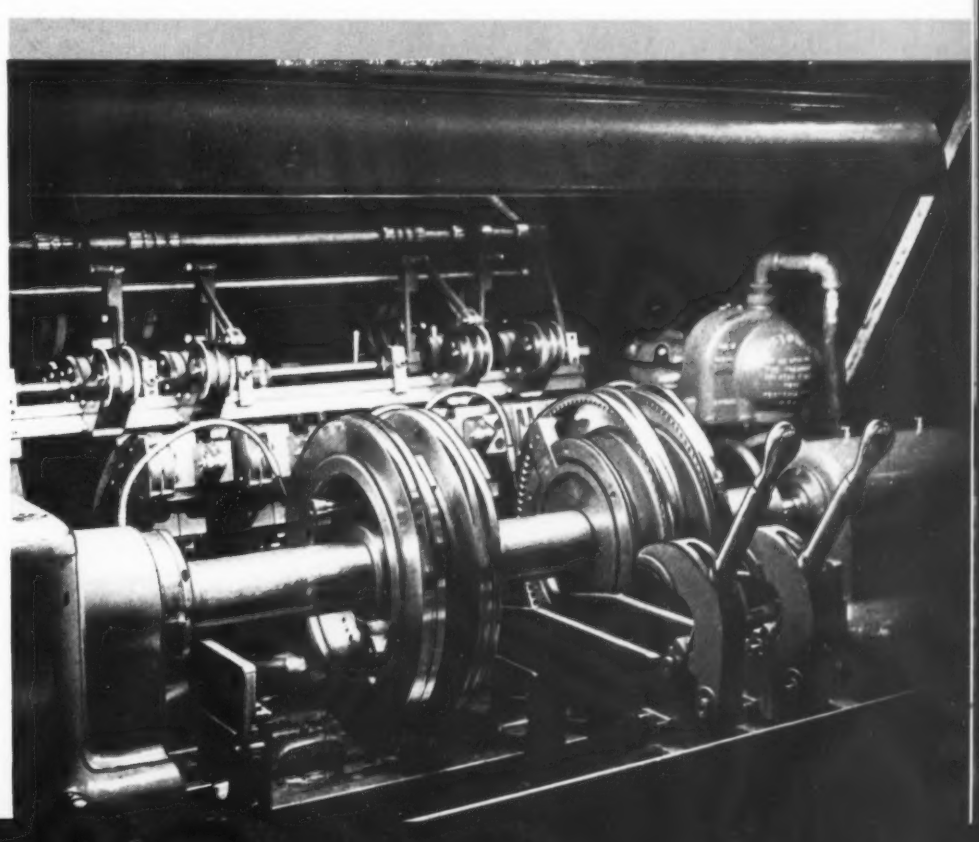


Fig. 11. Uniformity of Cam Lobes and a Fine Surface Finish are Obtained at High Production Rates on a Machine Using Abrasive Bands

burnishing tool is next advanced by a handwheel and engaged with the threads in the hole. When the threads become tight, a power-driven socket is engaged with a hexagon head on the end of the burnishing-tool holder, driving the tool further into the hole and drawing the lugs together in the same manner as a cap-screw. The stop acts as the head of the screw, and is backed up by an extremely heavy compression spring, adjusted to the desired weight.

When the driving torque on the tool reaches the predetermined value, the clutch is disengaged automatically and the drive stops. The machine is then reversed, and the tool driven in and out several times until the proper degree of burnishing has been obtained. This is determined by experience, three or four passes usually being sufficient. The tool is fluted; oil-holes in the flutes connect with a central oil passage through which oil is forced at considerable pressure by means of a pump and flexible hose.

Extensive use is now being made of silver plating for highly loaded bearings, which has made necessary the adoption of a new technique —ultra-violet, or "black-light" inspection. For various reasons, there may be areas to which the plating has not adhered, and these areas will ordinarily show up as blisters during a subsequent heat-treating operation. If, however, these areas are at the edge of the bearing or pin-holes exist through which vapors can escape, the blisters will not form and the defect cannot be discovered by ordinary inspection.

With the new inspection process, the parts are heated in a bath of oil and then allowed to cool. This causes a small quantity of the oil to be drawn under the surface of the plating at non-adherent areas. The surplus oil is then carefully removed and the part slowly heated. The heating causes the oil to be forced to the surface where it fluoresces and becomes visible when viewed under ultra-violet light, thus indicating the location of non-adhesion areas.

The extremely high degree of surface finish required on many engine parts necessitates a considerable amount of hand labor. This was particularly true of the lobes of cams, which were formerly finished by hand-stoning with 400- and 600-grit stones. A recently installed Norton Cam-O-Lap machine, shown in Fig. 11, now performs the work in a fraction of the time formerly consumed and with far greater precision and uniformity.

In an operation, two master cams and two work-pieces are set up on an arbor, and located by means of a stop engaging a marked tooth on the internal cam gear. Rollers in contact with the master cams control the movement of pressure pads which bear against the work-pieces and follow an identical path. Strips of No. 240 Aloxite cloth, fed from rolls at the back of the machine at the rate of approximately 7 inches per minute, pass between the pressure pads and the work. As the cloth is used it is picked up on a second spool from which it may be stripped for discarding.

The work-arbor rotates at about 60 R.P.M. A liberal supply of coolant is furnished, consisting of a mixture of two parts of Mineral Seal oil to one part of medium engine oil. The operating cycle is automatic. For seven minutes the

Fig. 12. Type of Lapping Machine that is Used for Obtaining Extremely Flat and Highly Finished Surfaces on a Large Number of Parts

Fig. 13. Two-spindle Lapping Machine Provided with High-speed Rotary Fixtures on an Indexing Table that is also Employed on Flat Surfaces

abrasive cloth is oscillated slightly, after which there is one minute of operation without oscillation of the abrasive. The surface finish obtained is 9 micro-inches, r.m.s.

The machine is adjustable within certain limits, but to avoid losing time in making adjustments when it is desired to lap the cam for a different model engine, two additional arms are provided. Separate arbors with the master cams permanently set up are used for each model.

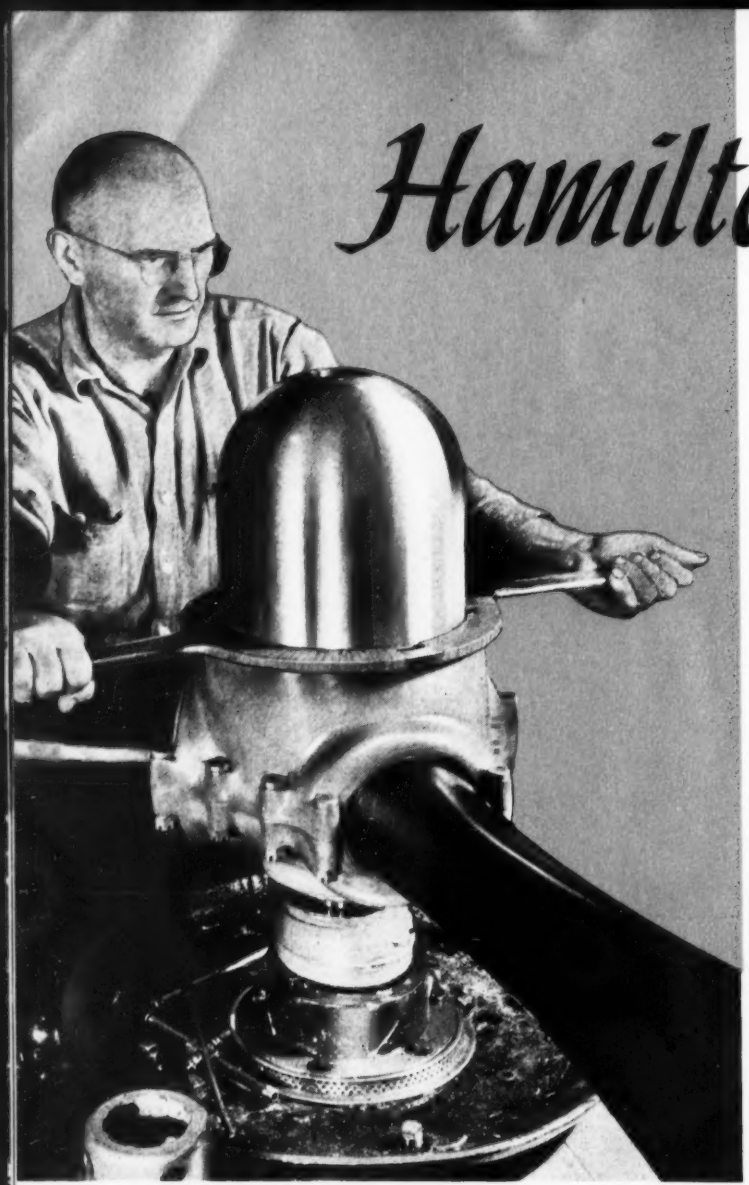
Extremely flat and highly finished surfaces are required on a large number of parts, both to insure trouble-free operation and to avoid oil loss. By the use of Ultra-Lap machines, parts are made flat to within 2 or 3 light bands on an optical flat, and with a surface finish of 2 to 3 micro-inches. It takes from one and one-half to four minutes, depending upon the size and shape of the part. These machines are equipped with an upper and a lower rotating spindle, as shown in Fig. 12, the upper spindle having an oscillating movement. Either spindle can be used for holding the lap, although it is common practice to use the lower one.

The lap is inserted in a recess in the spindle and charged with a suitable abrasive. The workpiece is then placed on top of the lap and the upper spindle brought into position over it. By means of a spider on the machine head, the spindle is brought down into contact with the work and power is applied. Driving is insured by means of a sponge-rubber pad on the end of the upper spindle, which also acts as a cushion to absorb minor differences in the height of the part. Driving pins may be employed in addition to the rubber, if the size or shape of the part makes it advisable. The illustration shows the end of a supercharger impeller shaft being lapped.

Some parts are lapped flat on Chapman universal honing machines of the type illustrated in Fig. 13. A finish of 1 1/2 to 2 micro-inches is obtained in a few seconds. This machine is equipped with two vertical high-speed spindles, driven by V-belts from 1/4-H.P. motors. The first spindle carries a 280-grit cup-wheel and is used for roughing, while the second is equipped with a 500-grit wheel for finishing. The work is held in four high-speed rotary fixtures, mounted on an automatically indexing table. A positive driver insures rotation of the part, but no clamps of any kind are employed. The spindles are adjustable to suit the height and diameter of the work.

At each indexing of the machine, the spindles are lifted pneumatically to clear the work, and then lowered again into contact with it, a light spring maintaining the desired pressure between the work and the wheel. The operation is continuous, parts being loaded and unloaded without stopping the machine. The work-holding fixtures, however, automatically cease rotating as they index into the front positions. The frequency of the indexings may be varied to five-, ten-, fifteen-, thirty-, thirty-five-, and forty-second intervals, the fifteen-second interval being the most commonly used. In addition to producing dead flat surfaces, this machine can be adapted to generate either concave or convex surfaces up to a full hemisphere by setting the spindles over at an angle.

Hamilton Standard IN THE



AT the Hamilton Standard Propellers plants in East Hartford, Conn., Norwich, Conn., and Westerly, R. I., large numbers of propellers of various sizes and types are being produced to meet the needs of our accelerating aircraft production program. Improved types have been developed to handle the greater and greater loads being placed on the aircraft-propelling mechanism as the result of the increased efficiency and power of the newer aircraft engines. Propeller tips now travel at speeds close to that of sound, and the centrifugal force exerted by some of the larger blades may equal the weight of four fully loaded freight cars.

Because of this, the propellers must be built to function as precision mechanisms. They must be accurately formed, exactly balanced, and adjusted to change pitch to any angle required by changing altitude and engine speed. It is this pitch-changing action, or rotation of each blade about its own longitudinal axis in synchronism with the other blades of the propeller to increase or decrease the pull exerted on the air, that adds complexity to the propeller mechanism.

The successful operation and long life of any complex mechanism is dependent in no small degree upon the accurate machining of many small parts, such as the spring-pack retainers shown being produced in Fig. 1. These retainers are broached in three operations from a 0.509- by 0.531-inch steel bar. The Lapointe broaching machine shown in the illustration cuts the inner square recesses for three retainers with the first set of broaches as the bar is fed into it horizontally. The second set of broaches forms the curved outer surfaces for three retainers after the work has been fed in further; and the third cut, taken by another set of broaches, separates the work into three finished pieces. All three broaching operations are performed simultaneously as the bar is fed through the machine, so that the three stages of work are continuously in progress.

A somewhat unusual grinding operation is shown in Fig. 2. This is the fourth operation on the forged ring-shaped dome retaining nut. In the first operation, both sides of the forging are surface-ground; in the second operation, the part is semi finish-bored; and in the third operation, the outside circumference is rough- and finish-turned.

In the fourth operation, three separate grinding wheels mounted on the same spindle are used, as shown in the illustration. The wheel in the middle grinds part of the bore to a diameter of from 9.637 to 9.639 inches, as shown in the line drawing, Fig. 3. The wheel at the right grinds another part of the bore to a diameter of from 10.012 to 10.014 inches, and also faces the inside shoulder to a depth of 0.687 inch from the face of the nut. The left-hand wheel grinds a ball groove of 3/32- and 5/32-inch radii, having a diameter of from 10.112 to 10.117 inches.

Hydromatic Propellers

MAKING

Present-Day Hamilton Standard Propellers are Complex Mechanisms with over 1300 Parts. Exact Machining, Careful Assembly, and Precise Balancing are Prerequisites for Their Successful Performance in Handling Greatly Increased Engine Power

By HOLBROOK L. HORTON

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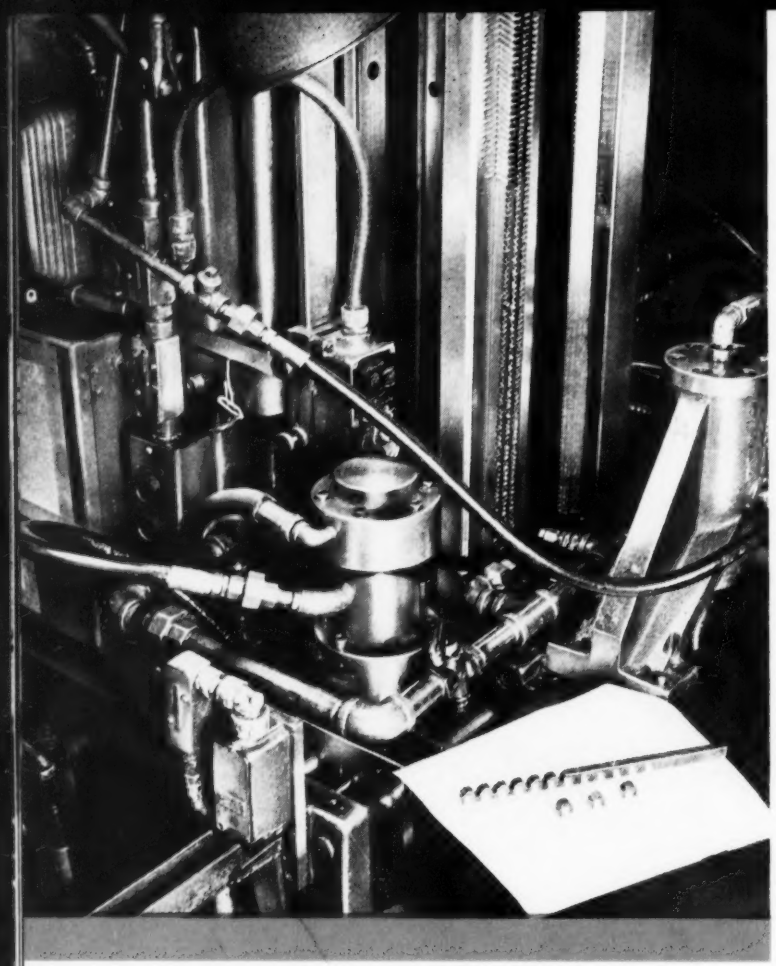


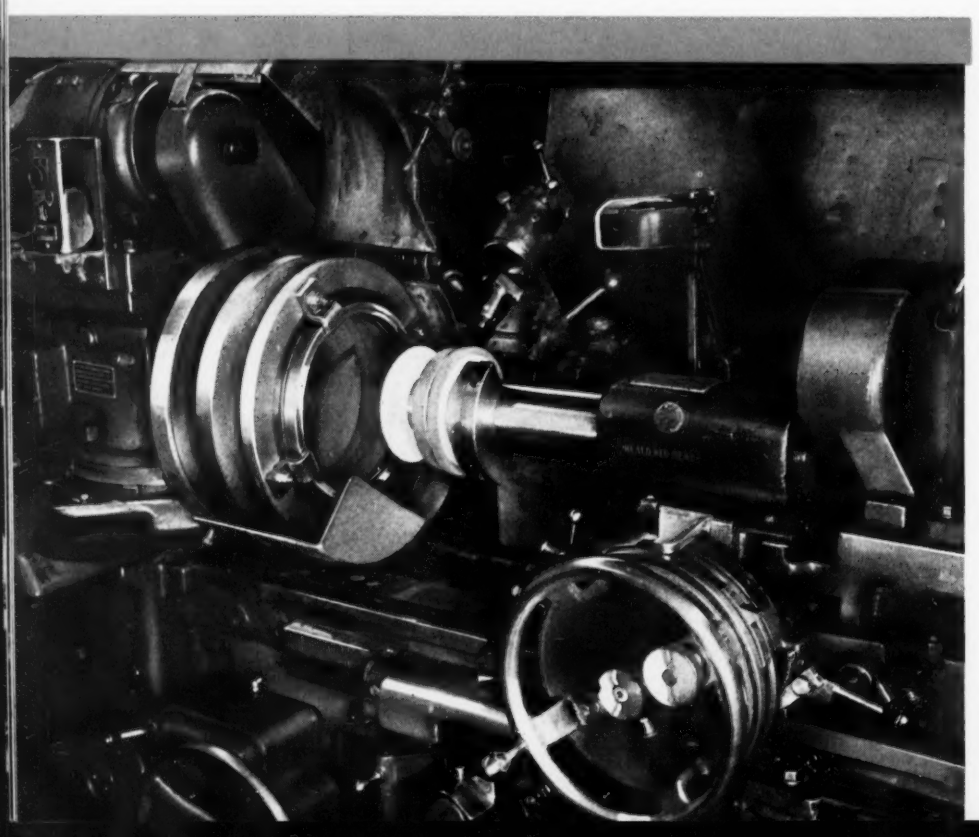
Fig. 1. Broaching Spring-pack Retainers from Steel Bar in Three Steps. Three Retainers and Examples of Cut Taken in First Two Steps are Shown in Foreground

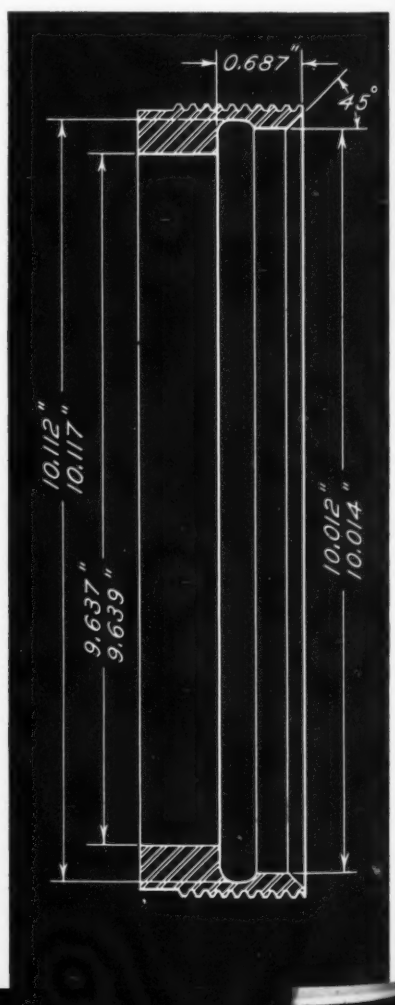
MAKING HAMILTON

Another broaching operation of interest is shown in Fig. 4, where the flats of a bronze propeller retaining nut are being cut. These eight flats—3.8125 to 3.8175 inches long—are broached two at a time by opposite broaches shown in a Lapointe machine. The blank is loaded on the work-holding spindle in the position shown, and is then rotated into the cutting position, in which the broaches move at right angles to the axis of the nut.

To provide an extremely tight fit of the blade bushing in the hub end of the blade, the propeller blades are heated and the bushings are refrigerated before being assembled under air pressure. In Fig. 5, a workman is shown removing a bushing from the refrigerating unit in which a temperature of — 45 degrees F. is maintained. Several propeller blades with hub ends inserted in an electric resistance type oven are shown near-by, and behind these may be seen bushings awaiting refrigeration. In Fig. 6, a refrigerated bushing is being inserted into a heated propeller blade under air pressure. About 40 tons total pressure is required to seat the bushing, and the application of this pressure is electrically timed to last exactly seventeen sec-

Fig. 2. (Below) Three Grinding Wheels Mounted on One Spindle are Used to Finish Two Horizontal Surfaces, Face a Shoulder, and Cut a Groove in Dome Retaining Nut. Fig. 3. (Right) Cross-section of Dome Retaining Nut, Showing Surfaces Ground





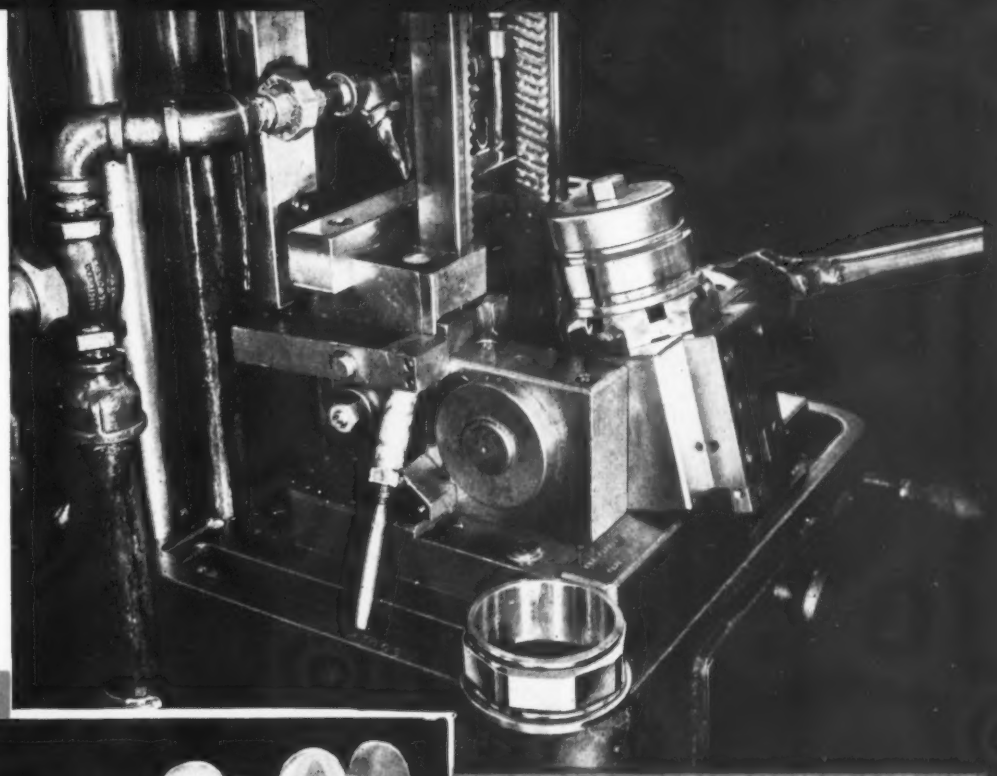


Fig. 4. (Right) Broaching a Round Bronze Blank to Form Eight Flats on a Propeller Retaining Nut. Two Flats are Broached at One Time

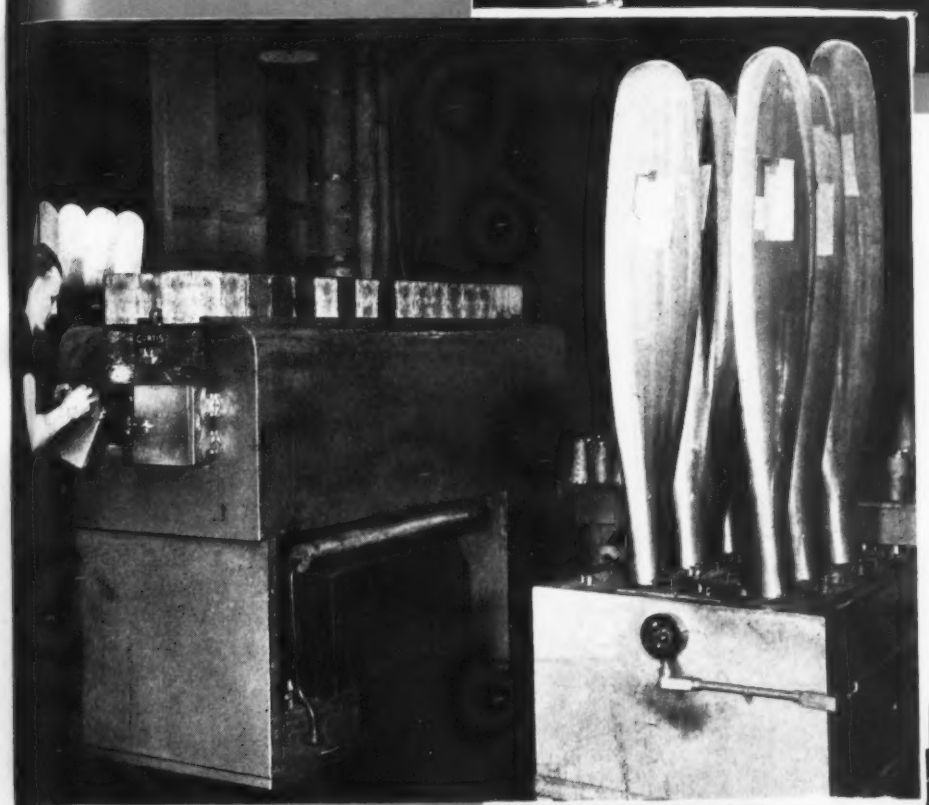


Fig. 5. (Left) Bushings to be Shrunk-fitted Inside Tapered Bore of Propeller Blades are First Refrigerated in Chamber at Left while Propeller Blades are Heated in Electric Oven at Right

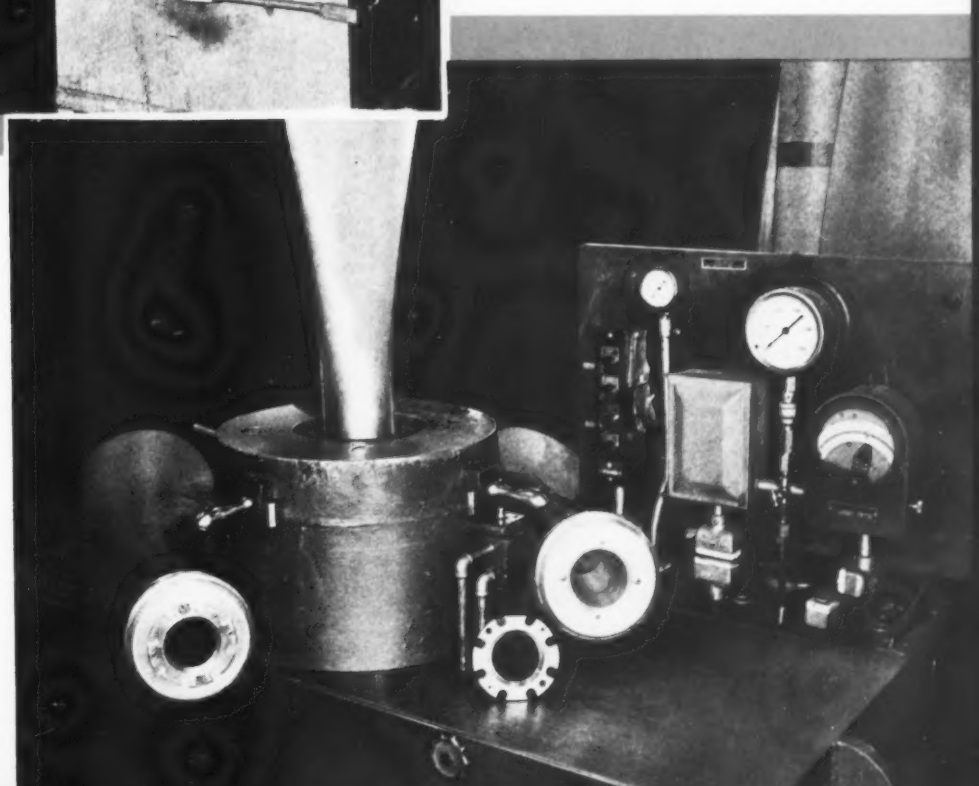


Fig. 6. (Right) Refrigerated Bushings are Inserted in Heated Propeller Blades under 40 Tons Pressure. An Electrical Timer Governs Exact Duration of Pressure

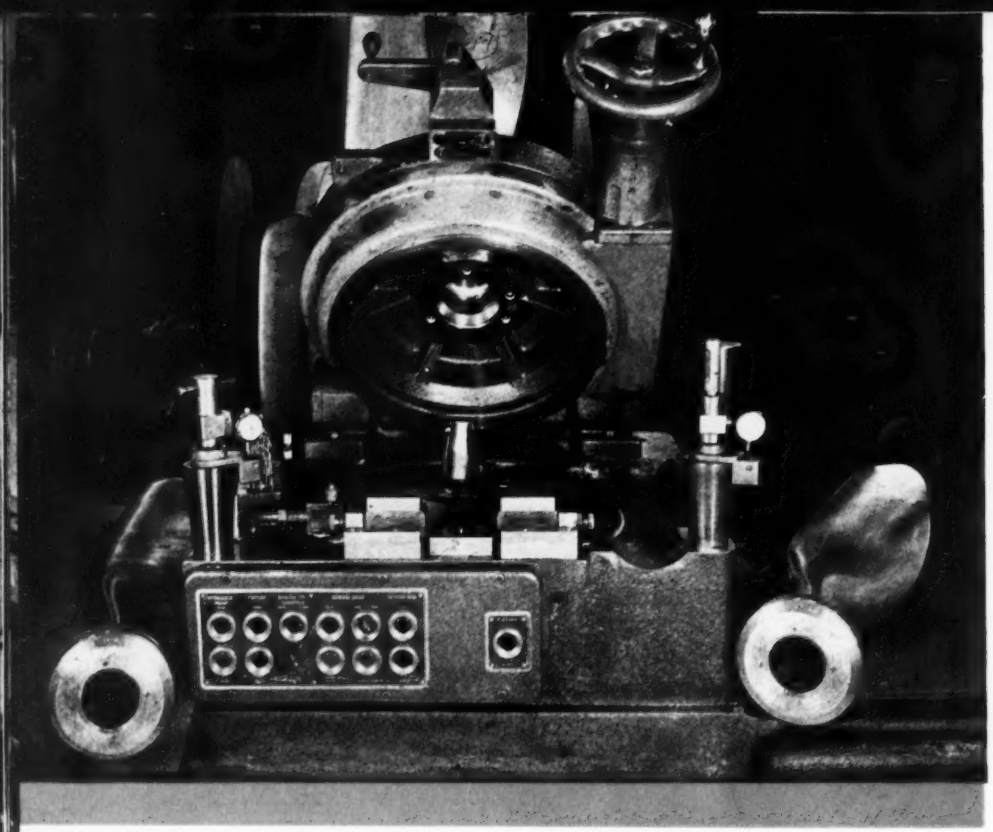


Fig. 7. A Single-point Boring-bar Set at an Angle is Automatically Fed up to Cut Taper Bore in Propeller Blade

onds. A propeller blade and the bushing to be assembled to it are shown separately at the right of the machine, while the assembled unit is seen at the left.

Before the bushing is seated, the propeller blade is taper-bored in a specially designed Heald Borematic. As shown in Fig. 7, the spindle of this machine is set at an angle from the vertical, and it is fed upward inside the hub which is held over the spindle in a vertical position. A taper cut of about 2 inches per foot for a distance of about 5 1/2 inches is taken. The entire operation is automatic, and requires only three minutes and forty seconds. Taper gages used to measure the bore before and after this operation are shown standing at the corners of the machine. A tolerance of 0.0006 inch is allowed in the vertical setting of the taper plug gage in the finished bore.

Although the aluminum-alloy forgings for the propeller blades are machined to the exact angle of twist at the time when they are cut to the proper contour, they may become slightly warped by the heat created during the subsequent processing operations. In that case, the Oilgear hydro-press shown in Fig. 9 is used to restore the correct angle to the blades. A pressure of about 400 to 600 pounds per square inch is applied successively at 6-inch stations marked off along the blade.

In Fig. 8, the beginning and end of the paint-finishing line are shown. The blades, hung on

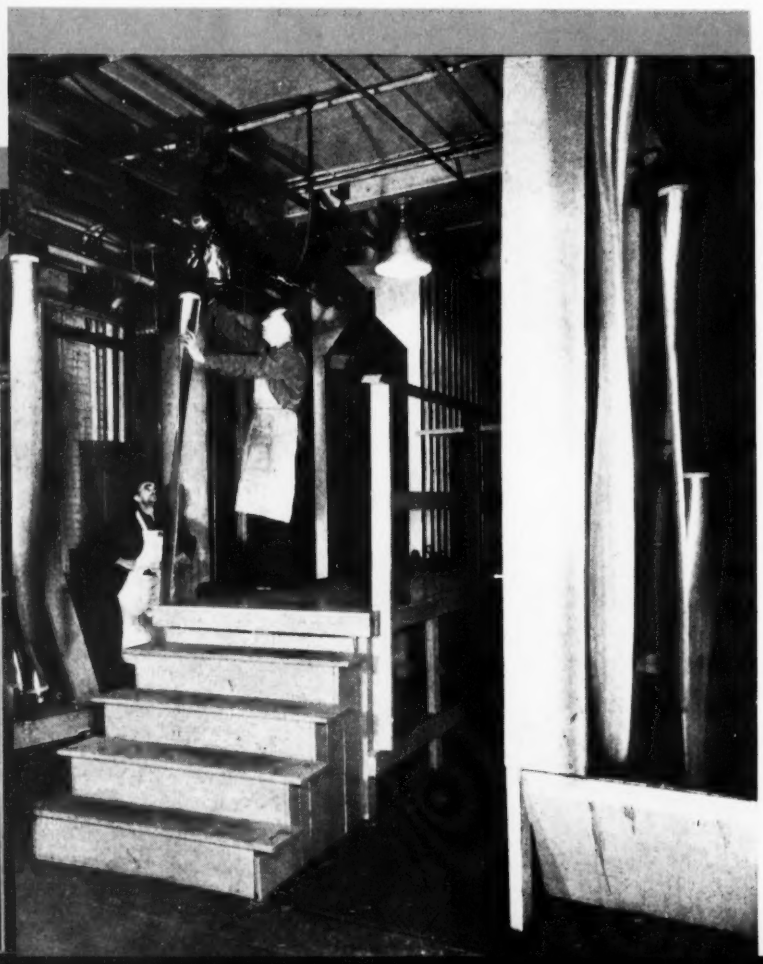


Fig. 8. Propeller Blades Going down into Degreasing Spray Chamber at Right. After Passing around through Painting and Drying Chambers, They Emerge at Left Ready for Assembly

Fig. 9. A Hydraulic Press is Used to Correct Any Angular Distortion in Blade Resulting from Heat-treatment

an overhead conveyor, are being carried down into a degreasing tank at the right where the degreasing fluid is sprayed over them. They then pass through a booth where zinc-chromate primer is applied, after which they enter a drying oven. When they have dried, they are given a coat of black over the entire blade, except for the tip, which is painted yellow. At the left, the finished blades are shown emerging from the hot-air dryer, ready for assembly.

Owing to the extremely high speed at which the rotating blades travel, even the slightest unbalance cannot be tolerated; therefore, although a propeller blade may be exactly balanced before it is painted, it is balanced again after the painting operation to correct any change in weight distribution which may have resulted from a slightly uneven application of paint.

Obtaining the final balance of the blade is a most exacting operation. An approximate balance is obtained by the insertion of washers on the stud of the taper plug inside the hub end of each propeller blade.

Final exact balance of the entire propeller assembly is obtained when it is mounted on a shaft laid across parallel knife-edges, as shown in Fig. 10. Small bits of lead wool are inserted in the hollow bolts which hold the assembly together. There are four of these bolts opposite each propeller blade, and lead wool inserted in them provides the necessary counterbalancing effect for the opposite blade if it is too heavy.

Fig. 10. Large Three-bladed Propeller being Given Final Balance Test. Bits of Lead Wool are Inserted in Hollow Bolts along Rim of Barrel between Blades to Provide Balancing Weight

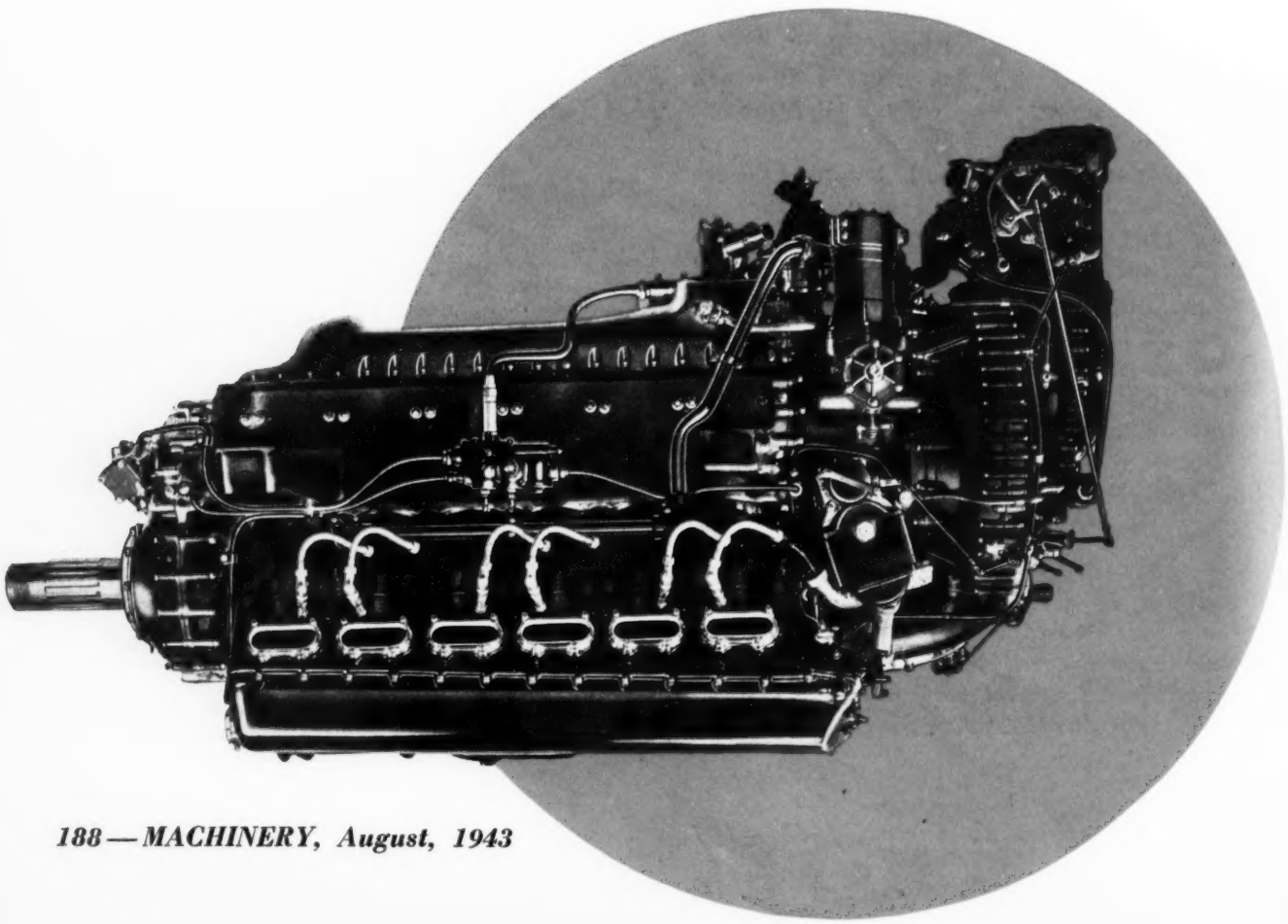
How Packard Builds the Rolls-Royce Merlin

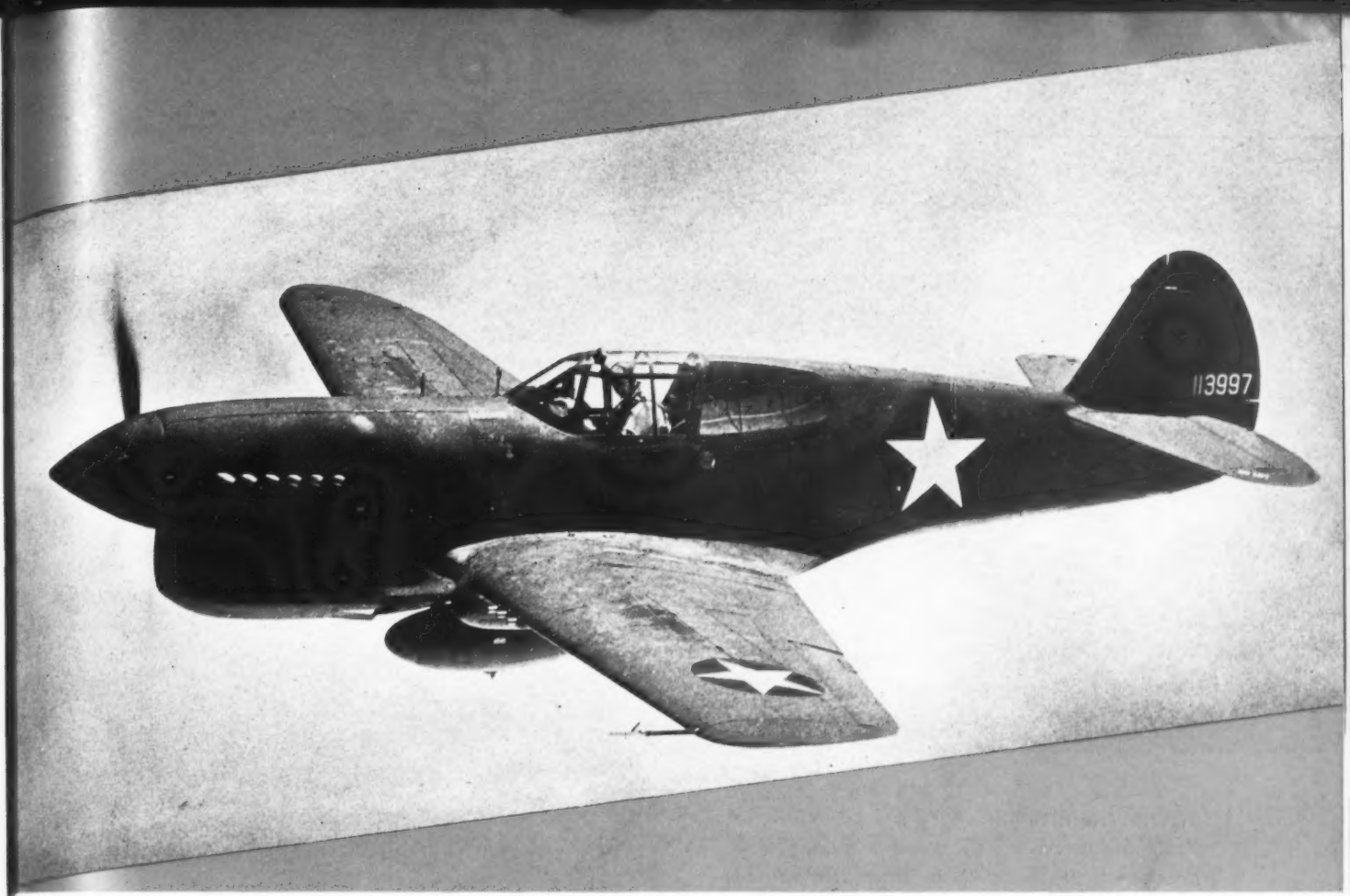
Taking an English Airplane Engine that was Designed for Manufacture by Skilled Craftsmen and Putting it into Volume Production, Using American Methods and Large Numbers of "Green" Workers, is an Outstanding Achievement of the Packard Motor Car Co.

By HOLBROOK L. HORTON

BRITISH-BUILT Rolls-Royce Merlin airplane engines earned an enviable reputation early in the war. They were the engines that carried the Spitfires and Hurricanes in for the "kill" when Nazi bombers started to devastate English cities and towns. Today American-built Rolls-Royce Merlins are being used to power the British four-motor Lancaster and twin-motor DeHaviland bombers and the Hawker Hurricane and American P-40 Warhawk fighters. An even more extensive use of these motors is anticipated in the near future.

To take this English-designed engine and put it into American production was a formidable undertaking. Not only did the Packard Motor Car Co. face the many difficult problems incident



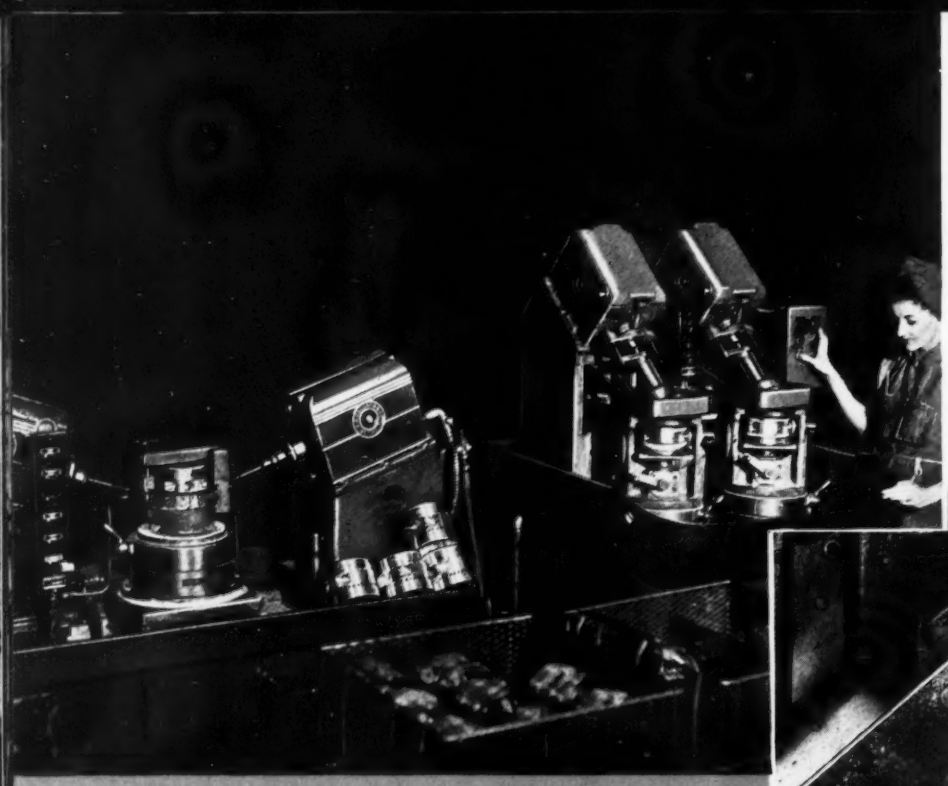


to conversion from peacetime to wartime manufacture, but, in addition, 2500 English "left-handed" blueprints had to be redrawn to conform to American "right-handed" practice, and this tailor-made engine had to be converted into a quality product quantity-built. So well did Packard do this conversion job that production was under way inside of ten months.

But even after adopting many American mass-production methods and devising new ones as well, these airplane engines cannot be turned out at anywhere nearly the same rate per man-hour or rather, say, per hundred-thousand man-hours as could the automobile engine. A few figures will make this clear. In the Packard-built Rolls-Royce engine, there are over 11,000 parts; in the entire 1942 Packard Clipper sedan there were 7140 parts. Between 75,000 and 80,000 operations are required to machine the 2000 major parts of the Rolls-Royce engine. It takes seventy-seven times as many standard hours to assemble this airplane engine as it did to assemble the Packard Super-8 automobile engine. Each operation, therefore, must be set up for as rapid production as possible and automatic controls must be provided wherever feasible, so that relatively unskilled workers can be taught to operate the machines in a minimum length of time.

By using automatic machines, which require only manual loading, unloading, starting, and stopping, it has been possible to train green workers to perform certain operations after only an hour and a half to two hours' instruction. In Fig. 1 are shown two Krueger automatic drilling machines, used for drilling a number of small oil-holes around an aluminum-alloy piston. The machine at the left drills twenty-four 1/8-inch holes around each piston, the work being indexed automatically from one position to the next, while the machine at the right drills six holes on one side of the piston and then is reloaded to drill six holes on the opposite side. Because each machine goes through its entire cycle automatically, two women are able to handle three machines of this type.

In Fig. 2 is shown a Sun Tool & Machine Co.'s two-spindle horizontal milling machine taking a clearance cut on each side of a piston. After the cuts are taken on the down stroke, the vertical traverse slide remains stationary and another piston is inserted to be machined on the up stroke. This operation was formerly accomplished with the work located in an indexing



HOW PACKARD

Fig. 1. (Left) Two Automatic Machines Drilling Oil-holes in Pistons. Four Women Operate Six of These Machines

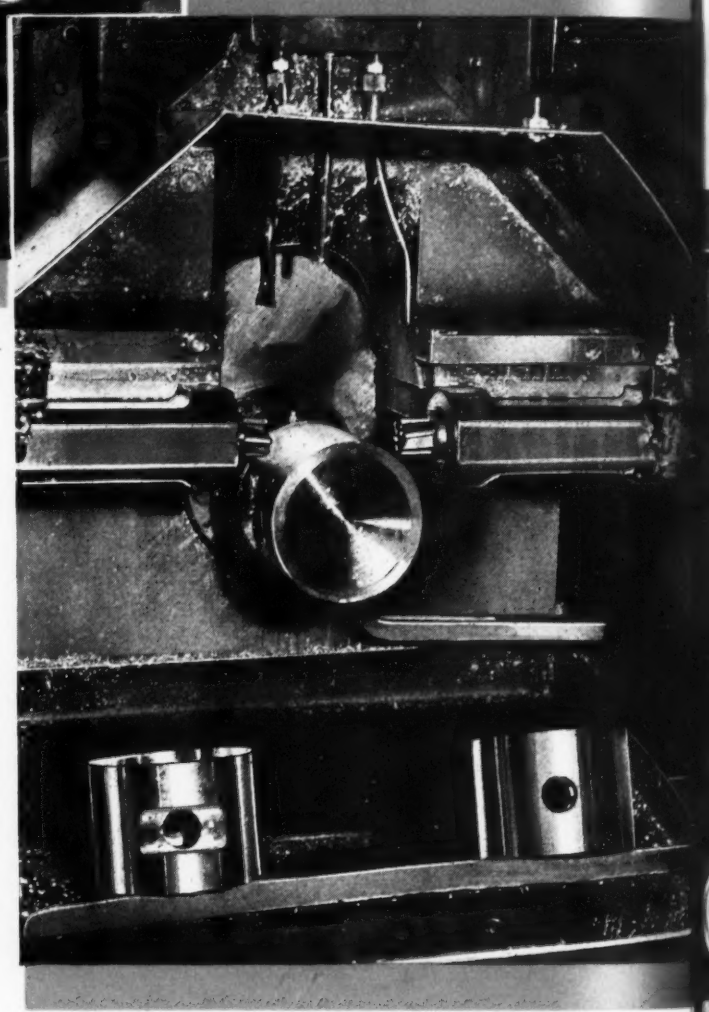


Fig. 2. (Right) Milling Clearance Cuts in Both Sides of a Piston. Work-spindle is Reloaded at Both Top and Bottom of Stroke. Finished Piece Seen at Left

fixture on a traversing table, using a plain type of milling cutter on a fixed spindle. The present method is about twice as fast as the former.

Fig. 3 shows a Snyder two-spindle contour milling machine taking clearance cuts inside a piston. In operation, the cutters are fed down inside the piston and then moved outward simultaneously until the roller on each spindle head comes in contact with a semicircular form block which guides each cutter during the milling operation.

The machine shown in Fig. 4 was especially designed by the Sun Tool & Machine Co. to profile-mill the inside of connecting-rod channels. The movement of the cutter is cam-controlled. Six-fluted right- and left-hand end-mills are used, and a maximum finishing cut of 1/32 inch is taken on each side of the rod. In three days, a woman can be trained to operate this machine, change the tools, and set up the work.

Another interesting operation on the connecting-rod is shown in Fig. 5. Here the outside diameter of the bosses is ground concentric with the piston-pin hole to a tolerance of 0.005 inch. Two grinding wheels, 16 inches in diameter by 7/8 inch wide, are set at an angle of 15 degrees with the plane of the work. A diamond dresser of unusual design is used to form the radii and flats on both wheels. The connecting-rod is rotated between the grinding wheels and is fed inward during the operation. The accuracy obtained by this method is well within the allowable limits.

Each Rolls-Royce connecting-rod is required to transmit as much power as is produced by an eight-cylinder automobile engine. It is of interest to note in this connection that it takes about eight times as long to machine a connect-

ing-rod for the Rolls-Royce engine as it does to machine a connecting-rod for an automobile engine.

In Fig. 6 the oil-cheeks of the main crankshaft are being plunge-ground with a flexible-shaft grinder. A finish cut of about 0.010 inch is taken, and the bevel is ground to a limit of plus or minus 0.005 inch. An expanding plug fitted in the bottom of each crankpin hole provides a bearing surface for the centering pin attached to the grinding-wheel spindle.

The crankshaft bores are honed in a vertical position on a W. F. & John Barnes honing machine, as shown in Fig. 8. Four-stone Micromatic hones are used, and the limits are plus 0.001, minus 0.000 inch.

For the final polishing operations, the crankshaft is mounted on a dolly that runs around an oval track, as shown in Fig. 7, where various steps in the polishing of web and cheeks of the counterweights are performed at each station, using Ingersoll-Rand compressed-air rotary heads.

The completed crankshaft is tested for precise balance on a Gisholt crankshaft balancing machine, as shown in Fig. 9, by means of weight and angle readings. The former is shown by the meter on the rear panel, and the latter by the dial affixed to the end of the rotating shaft. The operator can thus determine at exactly what point unbalance occurs and just how much excess metal needs to be removed to obtain the required balance. After testing in one position, the crankshaft is turned end for end and tested again. It takes fifty-four standard hours to assemble a Rolls-Royce crankshaft, compared with about three and a third standard hours for a Packard automobile engine crankshaft.

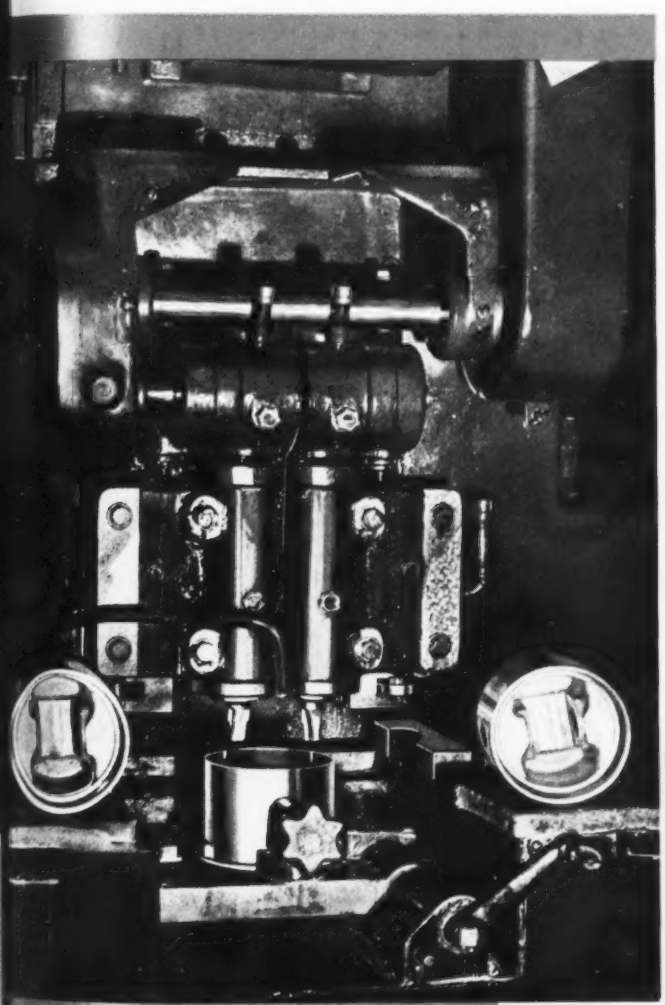


Fig. 3. (Left) Vertical Milling Machine with Two Independent Heads Takes Clearance Cuts on Both Sides of Piston Cavity. Finished Piece is Shown at Left

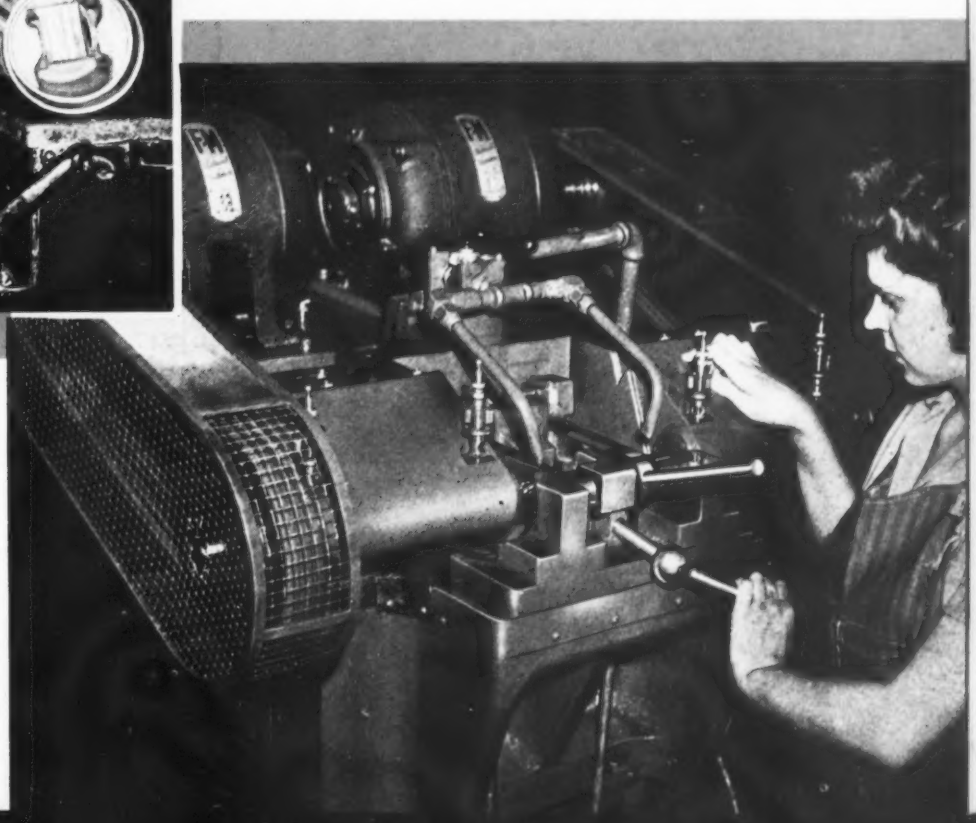


Fig. 4. (Right) Special Machine Designed to Profile-mill Inside of Connecting-rod Channel

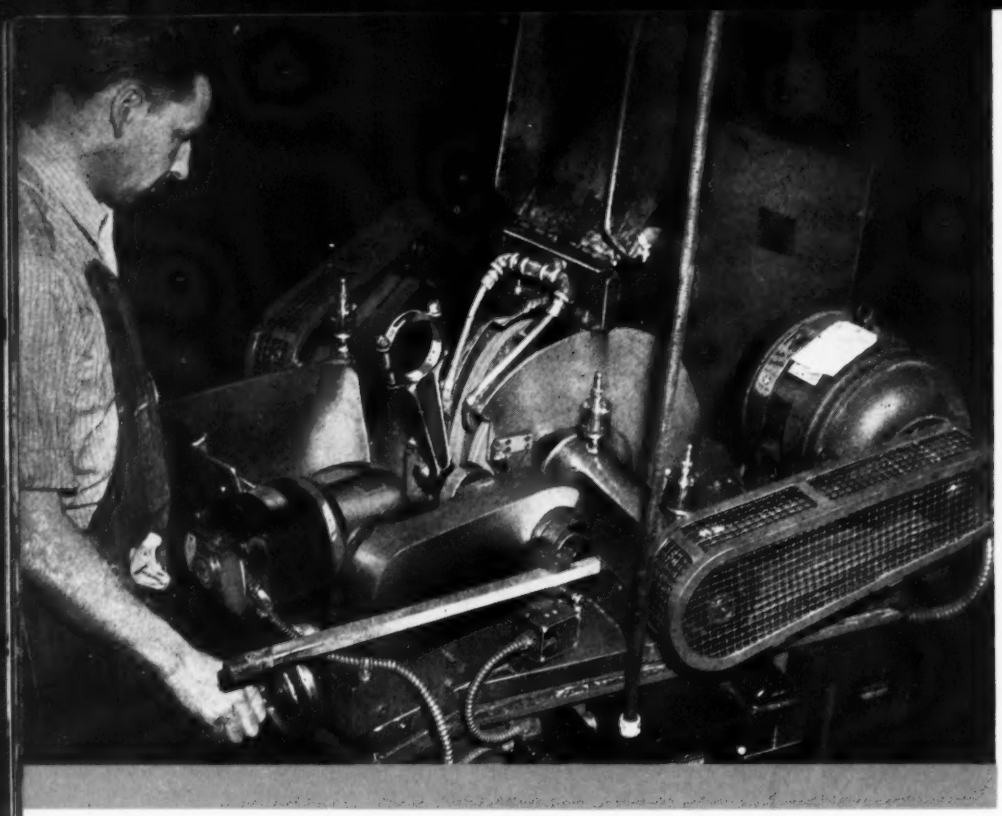


Fig. 5. Ingenious Set-up Used in Grinding the External Diameter of the Bosses around the Piston-pin Hole

After the initial rough-machining operations on the engine crankcase, the upper half is given a vapor degreasing and is then placed on cradles, which permit the casting to be turned end for end. These cradles move continuously around an oval track where various hand-cleaning operations are performed, as shown in Fig. 10. Each casting passes twenty-seven separate stations, where burrs, sand, rough spots, and other irregularities are removed. Some idea of the number of small recesses that must be cleaned out may be gained from the inside view of the casting shown standing in the foreground. Two straight-line casting-cleaning lines are also in operation in this department.

In Fig. 11 is shown the upper half of the crankcase in a W. F. & John Barnes boring mill. Here the main bearings are bored and counterbored; the reduction gear end is bored and faced; the pinion gear bearing is bored; the generator housing opening is bored, faced, and chamfered; and the idler gear hole is faced and bored.

All finished dimensions, including the main bore location and the cylinder bank dimensions of the upper half of the crankcase, are checked on the two inspection fixtures shown in Fig. 12. The fixture in the background is used to check eighteen different dimensions and the one in the foreground seven different dimensions. The tolerances are within 0.001 inch.

A large number of drilling and tapping operations on the aluminum-alloy wheel-case, where a majority of the accessories are connected, are performed successively on three Natco drilling machines, two of which are shown in Fig. 13.

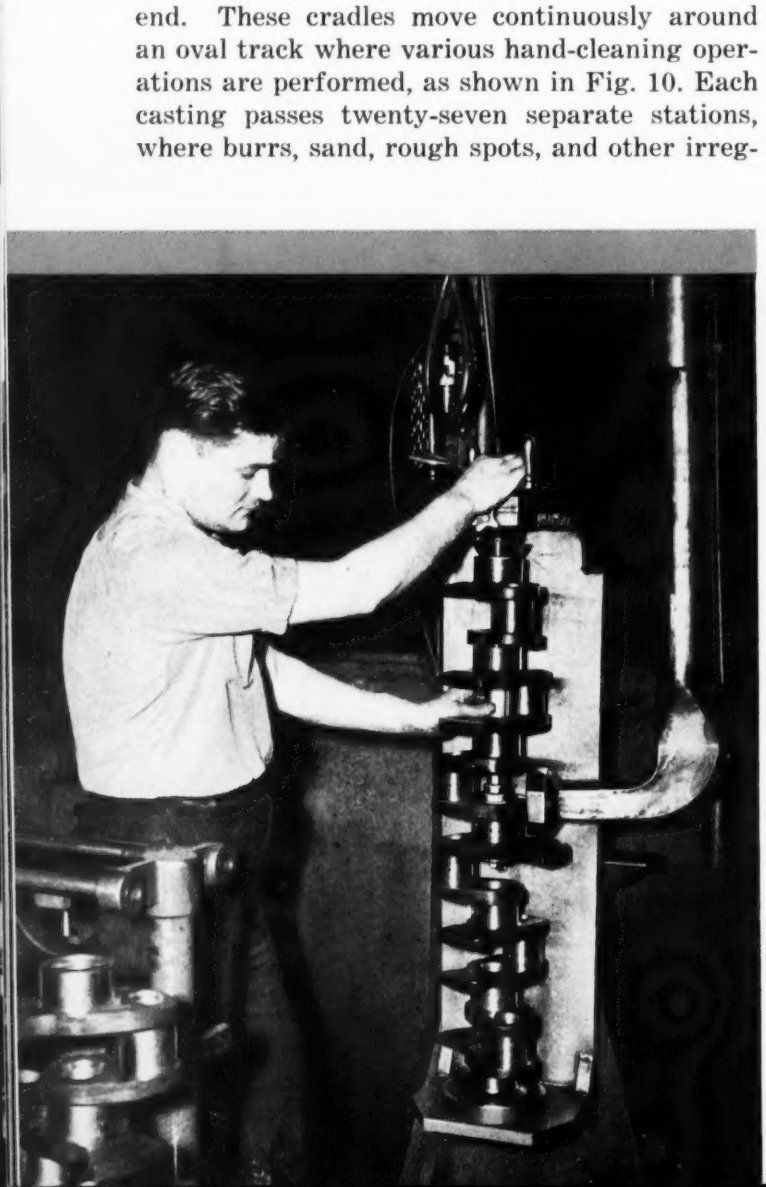


Fig. 6. Plunge-grinding Oil-cheeks of Main Crankshaft with Flexible-shaft Grinder. Expanding Plug beneath Wheel Acts as Centering Device

Fig. 7. Polishing Operations on Crankshaft are Conducted at Successive Stations around an Oval Conveyor Track

The work-piece is held in a fixture which rotates in a vertical plane, indexing to each drilling or tapping position. This fixture, in turn, is mounted on a carriage which may be quickly moved to the correct drilling position under each machine. Fifty-eight holes are drilled and finish-tapped on the two machines shown. Thirty-six holes are drilled and finish-tapped on the first machine (not shown in the illustration), which is located at the left.

Two and one-half hours have been saved per wheel-case by finish-tapping directly after drilling. One man operates these three machines. Ziegler floating taps are used. The holes range from 0.156 to 0.375 inch in diameter, and have twenty threads per inch. Formerly, the holes were rough-tapped by machine and then finish-tapped by hand.

In Fig. 14 is shown a specially designed machine, built by the Sun Tool & Machine Co., for cutting off surplus stock from the inside scroll-shaped cavity of the supercharger housing. A single-point cutting tool is used, which is controlled by a cam to generate the proper contour. As the cut is not continuous, due to the fact that there is an opening into the cavity, the cam is designed to give the cutting tool quick withdrawal and approach at this point. After cutting off the surplus stock, the cavity is finished by polishing. Before this machine was designed, the entire amount of surplus stock was removed by hand-polishing, which required a considerably longer time.

The exactitude with which the seventy-two gears used in each Rolls-Royce Merlin engine are cut and finished is of paramount importance

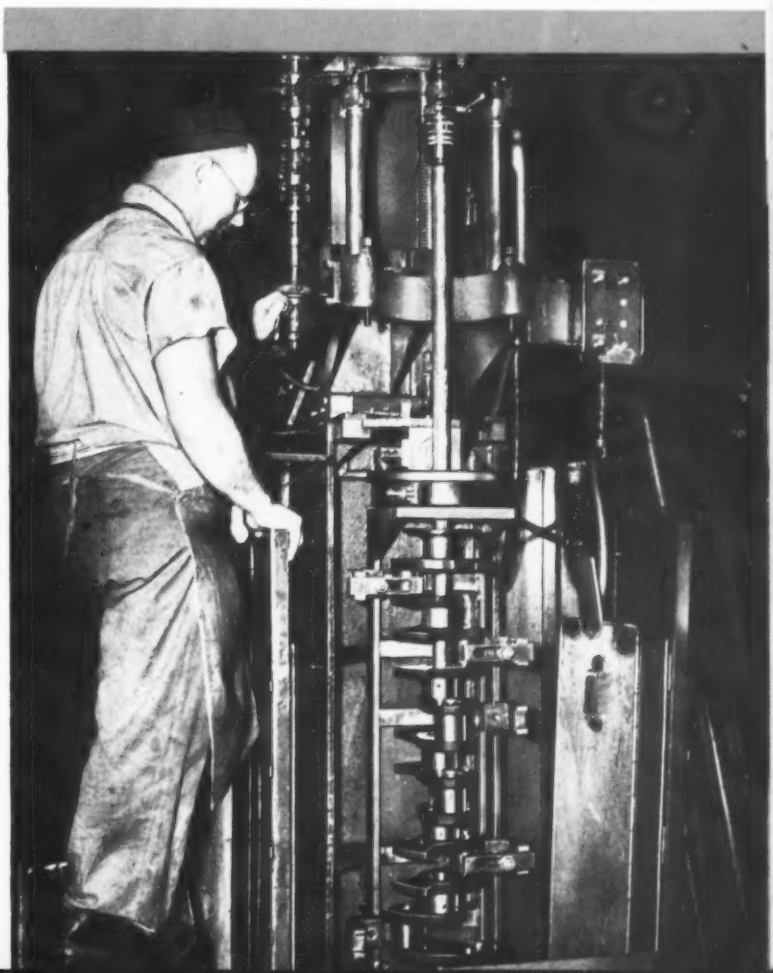


Fig. 8. Honing the Bores in the Main Crankshaft on a Vertical Honing Machine within Limits of Plus 0.001 Inch, Minus Zero

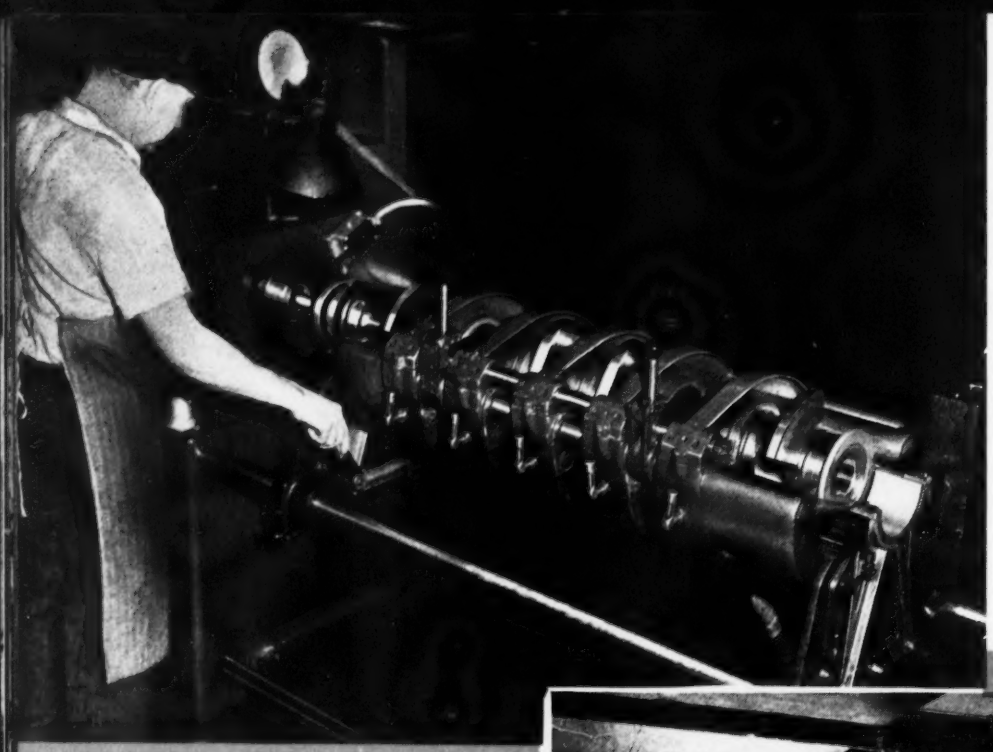


Fig. 9. (Left) Balancing a Crankshaft on a Machine that Measures Amount of Excess Weight and Exact Angle at which This Weight Must be Removed

Fig. 10. (Right) The Upper Half of Each Crankcase is Carried around a Continuously Moving Line for Thorough Cleaning before the Finish-machining Operations are Begun

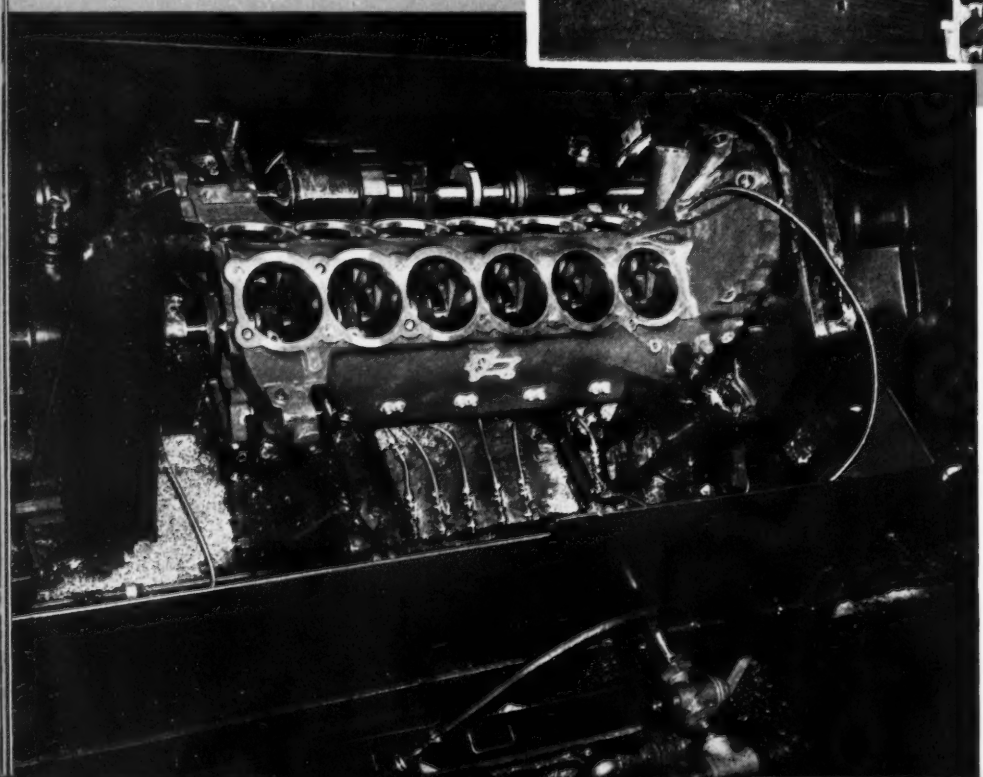


Fig. 11. (Left) Performing Several Boring Operations Simultaneously on Crankcase, Using Horizontal Boring Mill

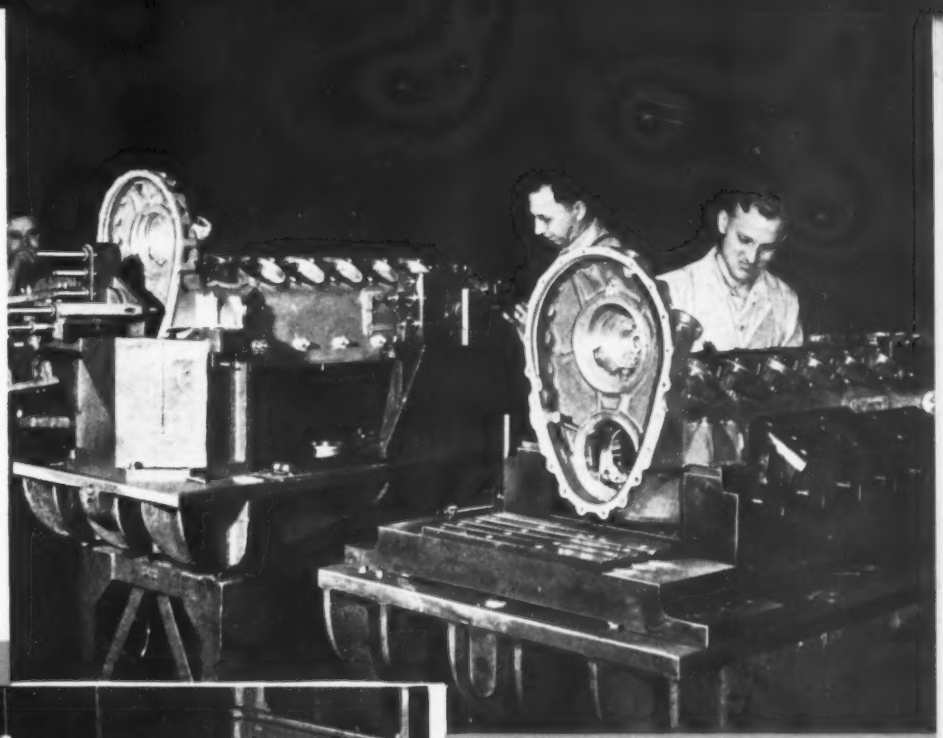


Fig. 12. (Right) Two Inspection Fixtures Used to Check Critical Dimensions of Crankcase. The Rear Fixture Checks Eighteen Dimensions; the Front Fixture, Seven

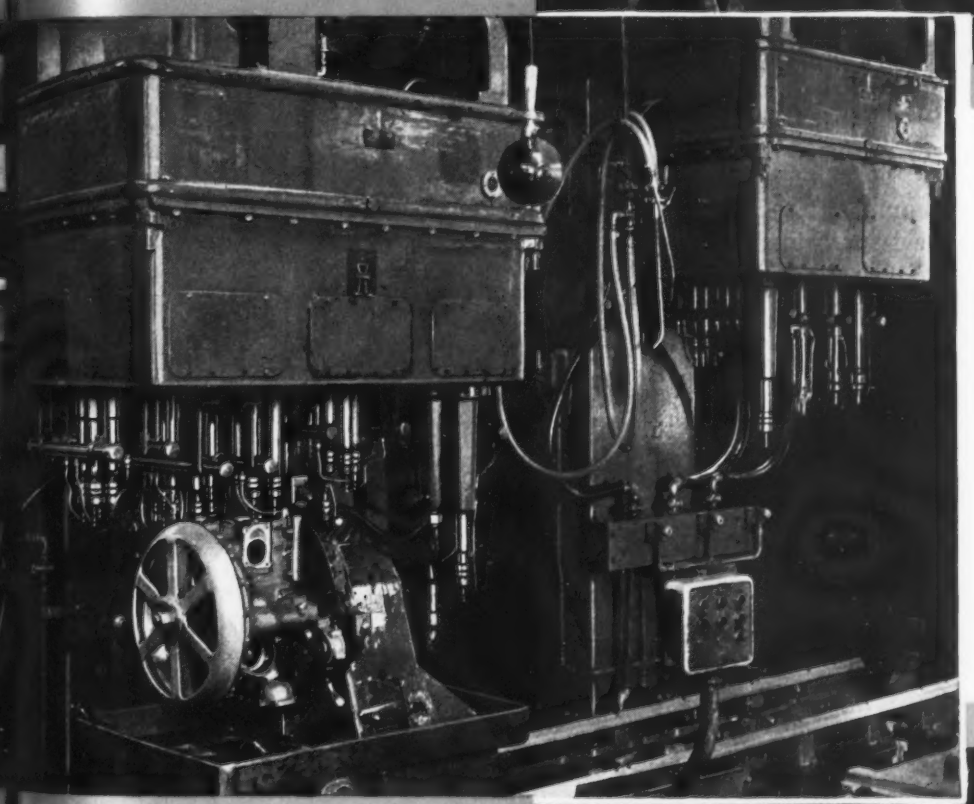


Fig. 13. (Left) Two of Three Multiple-spindle Drilling and Tapping Machines that Perform Successive Operations on Wheel-case. A Rolling Carriage Moves Work between Machines

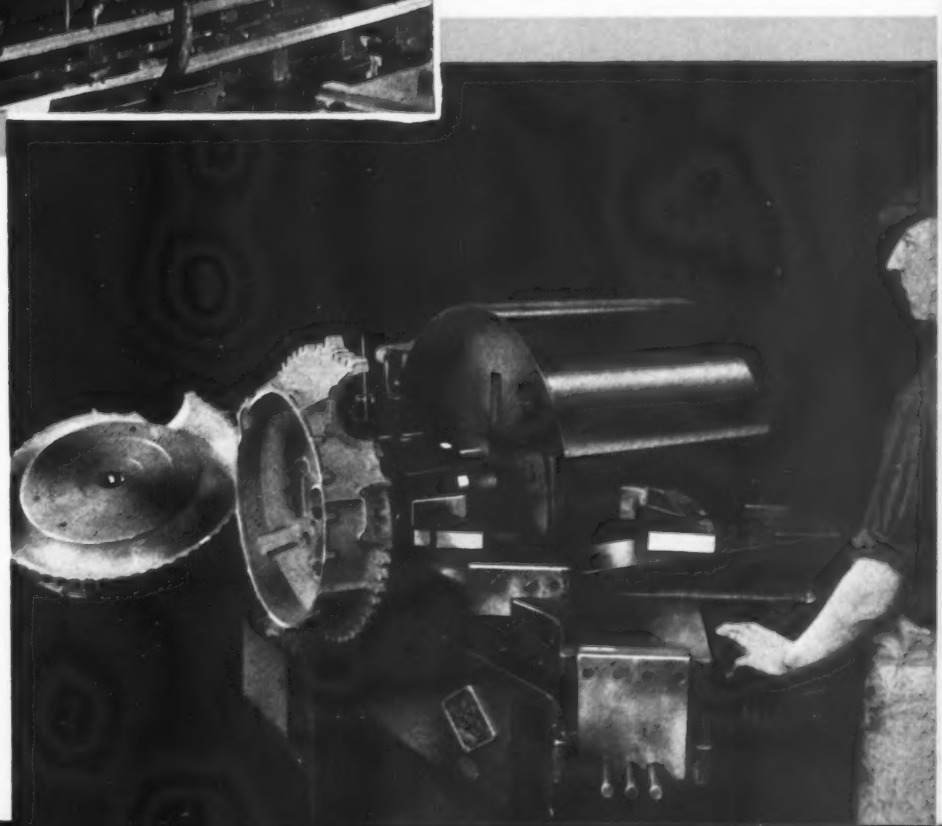


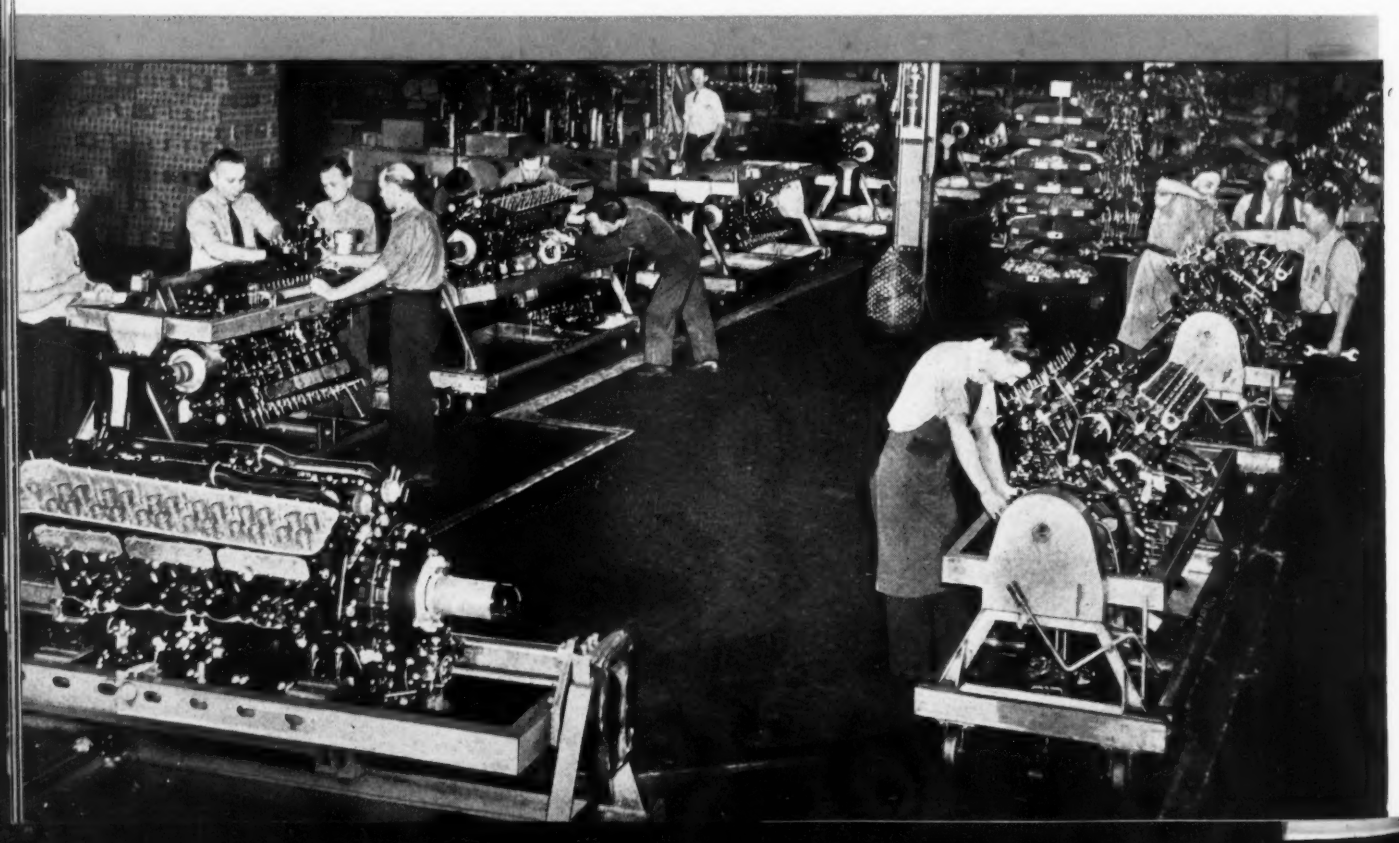
Fig. 14. (Right) Special Machine Designed to Rough out Scroll-shaped Cavity in the Supercharger Housing

Fig. 15. Seventy-two Gears are Used in Each Engine. These Electrically Indicating Gear-checking Machines are Utilized to Maintain the Close Tolerances Required

to its smooth running and maximum life. In Fig. 15 are shown some of the electrically indicating gear-checking machines used for checking tooth spacing, lead, and involute profile. As an example of the accuracy required, the spacing between adjacent teeth must be within 0.0003 inch, and between a given number of teeth, 0.0005 inch.

As shown in Fig. 16, Packard assembles the Rolls-Royce Merlin engine on a continuously moving line which progresses around an oval-shaped track. Sub-assemblies for this engine move down straight assembly lines to the point where they are attached to the engine itself. The dollies that support these engines during assembly have a rotating frame which can be turned to any convenient position. Trays in the bottom of the dollies are used to carry sub-assemblies or parts at certain stages along the assembly line.

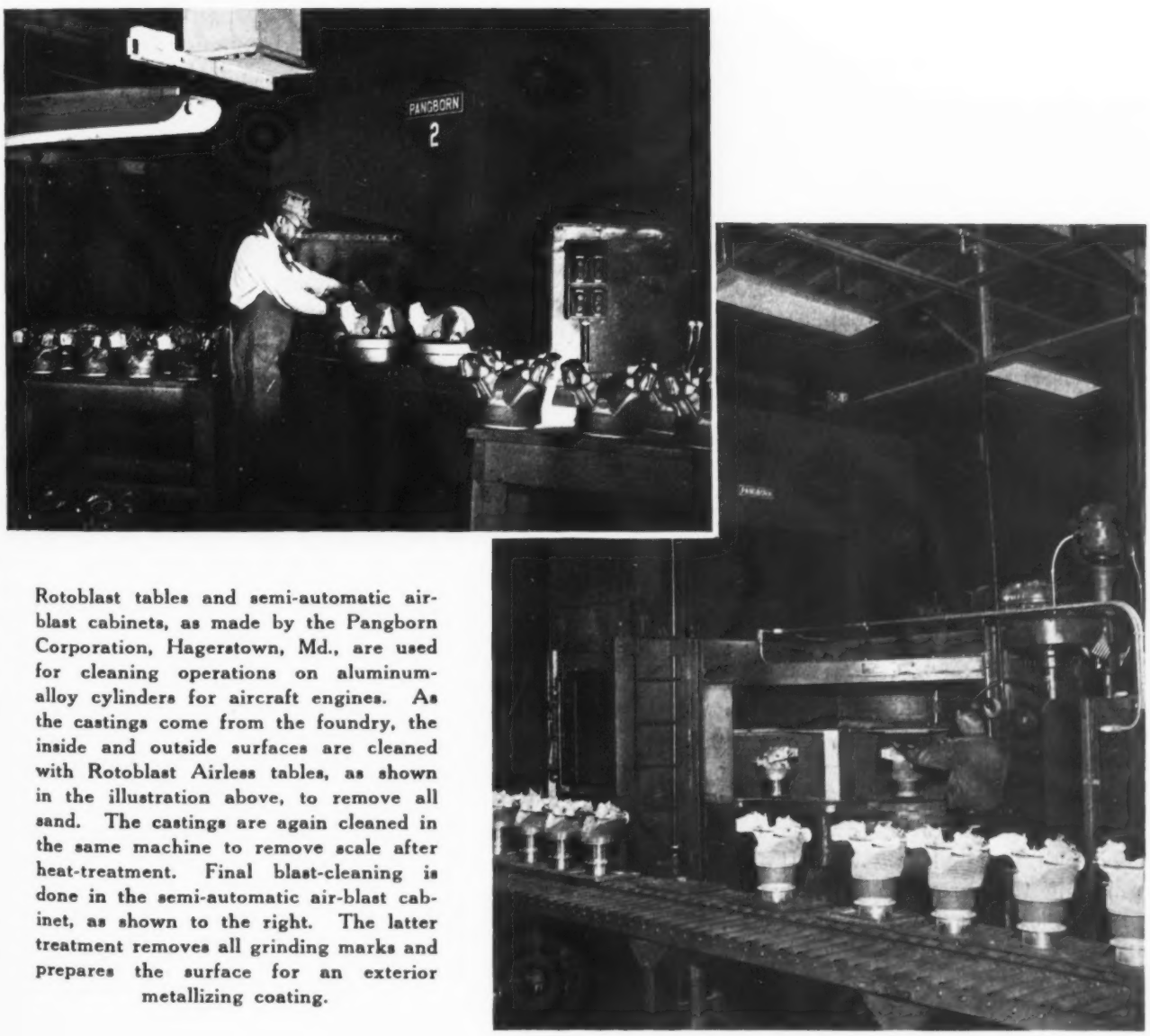
Fig. 16. Rolls-Royce Merlin Engines Nearing Completion as They Progress Along the Continuously Moving Assembly Line



National Metal Congress to be Held in Chicago

PLANS for the twenty-fifth annual National Metal Congress, to be held in Chicago during the week beginning October 18, have been announced. The Palmer House will be the headquarters. The entire Metal Congress and displays will relate to war production in the metal industries and to the conservation of metals. The technical sessions will deal specifically with war production problems, with a view to aiding in overcoming difficulties in the war manufacturing plants.

Four large national societies will again cooperate in the forthcoming Metal Congress. In addition to the American Society for Metals, which sponsors the meeting and the displays, the American Welding Society, the Wire Association, and the Iron and Steel and Metals Divisions of the American Institute of Mining and Metallurgical Engineers will hold meetings in Chicago at that time. The Welding Society will have headquarters at the Morrison Hotel; the Wire Association, at the Hotel LaSalle; and the American Institute of Mining and Metallurgical Engineers, at the Hotel Sherman. The conference displays will be shown in special rooms at the Palmer House.



Rotoblast tables and semi-automatic air-blast cabinets, as made by the Pangborn Corporation, Hagerstown, Md., are used for cleaning operations on aluminum-alloy cylinders for aircraft engines. As the castings come from the foundry, the inside and outside surfaces are cleaned with Rotoblast Airless tables, as shown in the illustration above, to remove all sand. The castings are again cleaned in the same machine to remove scale after heat-treatment. Final blast-cleaning is done in the semi-automatic air-blast cabinet, as shown to the right. The latter treatment removes all grinding marks and prepares the surface for an exterior metallizing coating.

the arrow. At this point, the toothless portion of gear *C* is passing under gear *D*, and there is no connection between the two, but as gear *D* meshes with gear *E*, which, at this point, is being driven by gear *B*, gear *D* is caused to rotate in the direction indicated by the arrow. In rotating in this direction, however, no useful work is performed, the gear simply acting as an idler. Thus, the motion of shaft *A* is transmitted in the opposite direction to shaft *H* through gear *E*, while gear *D* and shaft *G* idle, or rotate without transmitting any motion.

Referring to Fig. 2, shaft *A* is shown in the position it occupies after one-half revolution, which brings the teeth of gear *C* into mesh with gear *D*. Gear *E*, meshing with gear *D*, is rotated in the direction shown by the arrow and, being keyed to shaft *H*, serves to drive the latter member. At this point, the toothless portion of gear *B* is passing under gear *E*, there being no connection between these two members. Thus the rotation of shaft *A* is transmitted in the same direction to shaft *E* through gears *D* and *E*. The end teeth of gears *B* and *C* are modified in shape as required to provide the clearance necessary for practically instantaneous reversal of the direction of rotation.

Friction Driving Mechanism for Rewinding Roll

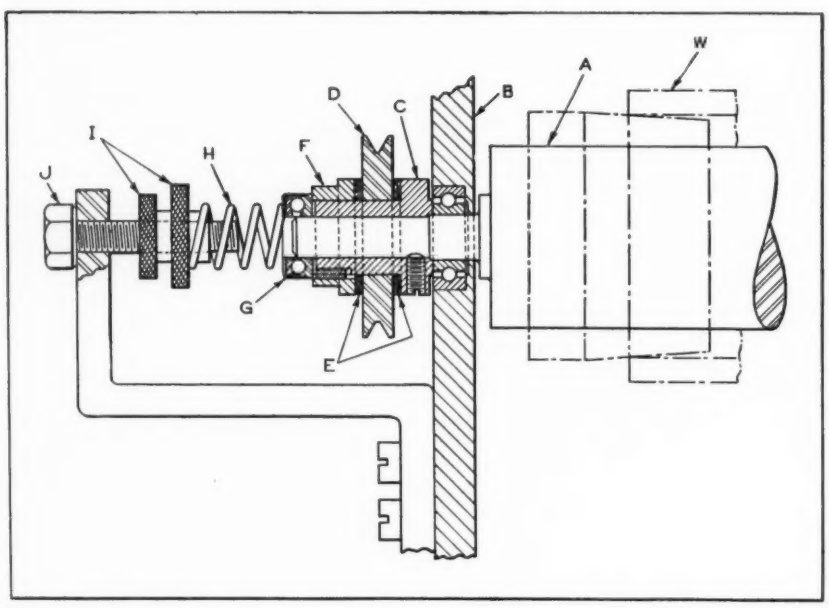
By P. E. VERAA

A friction driving mechanism that has been found a practical means for driving a roll used in rewinding a paper or cloth web is shown in the accompanying illustration. This mechanism was designed by the writer specifically for rewinding cloth on a dyeing pad. Modern printing presses and paper-coating machines are, of course, equipped with an elaborately designed unit for automatically controlling the web tension and compensating for the constantly increasing diameter of the roll of rewind material. For a small proving press or laboratory model, however, the use of a simple and flexible friction driving unit is desirable.

In this case, the rewind unit is not required to pull the web through the operating rolls. It is only necessary for the unit to keep the material under tension within limits that will prevent wrinkling. Owing to the light amount of power needed, the friction adjustment must be very sensitive.

Referring to the illustration, the speed of the driven pulley *D* must be so adjusted that it is approximately 2 per cent higher than the minimum web speed when starting at the small diameter of the rewind core *W*. Pulley *D* is a running fit over bronze hub *C*, which is secured to the extension shank of the rewind roll *A* by set-screws or dowels. Two leather washers *E* on each side of the pulley provide the necessary friction for driving the roll when sufficient pressure of spring *H* is applied to collar *F*. All bearings are of the anti-friction type, including the roll-supporting bearing in the frame *B*.

A feature of this rewind mechanism is the spring pressure adjustment provided by stud *J* and nuts *I*, which can be easily changed while the machine is in operation. The thrust ball bearing *G* is preferred to an ordinary thrust washer because the face of the latter, revolving against the end of spring *H*, would reduce the sensitivity of the mechanism.



Rewinding Roll Equipped with Friction Driving Mechanism

* * *

The following definitions not found in Webster's Dictionary are quoted from a contemporary source:

A committee is a group of men who individually can do nothing, but who as a group can meet and decide that nothing can be done.

A statistician is a man who draws a mathematically straight line from an unwarranted assumption to a foregone conclusion.

A bureaucrat is a man with a passion for regimentation but who has no ability to direct it.

An economist is a man who makes simple things complex.

How to Secure Fine Surfaces by Grinding

By H. J. WILLS, Engineer
The Carborundum Co., Niagara Falls, N. Y.

Fourth of a Series of Articles Describing the Factors Governing Fine Surface Quality and the Means by which This Quality Can be Obtained

THE cutting action of any grinding wheel will vary with changes in the area of contact between wheel and work, the ratio of wheel and work speeds, the rate of traverse, and the amount of in-feed. To determine the proper operating conditions for a well selected wheel on a machine that is in good running order or to manipulate a wheel that is not exactly suited to a job so that it will give satisfactory results, the grinding operator must understand how these factors affect wheel performance.

For the best and most economical grinding, the magnitude of the stresses set up in the wheel by any of the movements of the work relative to the wheel should be close to the point where the abrasive crystals will fracture and where the grains will be torn from the bond. Then any increase in these stresses will break the crystals or tear them from the bond, that is, the wheel will *act* softer. On the other hand, any decrease in these stresses will cause the grains to become dull long before they are pulled from the wheel, and the wheel will act harder.

Fundamentals of Action between Wheel and Work

The magnitude of the stresses set up is dependent in part on the area of contact between the wheel and the work. This area of contact is the product of the length of the arc cut in the work by the wheel and the width of the cut—that is, the width of the wheel face, except where the wheel passes off the edge of the work.

Since, for any given rate of in-feed, the total pressure between the wheel and the work is constant, it is evident that the unit pressure acting on an individual grain is greater when the total area of contact of work and wheel is small, and less when this area is large. That is, decreasing the area of contact will make a wheel act softer, and increasing the area of contact will make it act harder.

If, while the wheel speed is kept constant, the work speed is increased, each abrasive grain will have to cut out a larger chip, thereby increasing the stress to which it and the bond that holds it is subjected, so that the wheel will act softer, and vice versa. Obviously, the same changes in ratio between work and wheel speed can be achieved by changing the wheel speed while the work speed remains the same. However, since any considerable increase in wheel speed is dangerous, and any marked decrease reduces production, it is better, under ordinary conditions, to leave the wheel speed unchanged and to secure the desired change in ratio by manipulating the work speed alone.

As a wheel wears, its surface speed in feet per minute becomes less, which increases the work-wheel speed ratio, and the area of contact decreases—both of which tend to make the wheel act softer. To avoid this, the wheel speed should be increased or, if the machine will not permit that, the work speed should be reduced to the point where the correct ratio will be maintained. The latter procedure may, however, decrease production seriously.

Since the traverse sets up shearing forces in the wheel, it is obvious that the faster the traverse, the softer the wheel will act, and vice versa. Heavy in-feed, because it increases the unit pressure on the wheel face, makes a wheel act softer than it would at a lighter in-feed, and vice versa.

The Selection of Wheel, Work, and Traverse Speeds

Having selected a grinding wheel well suited to the job at hand, the next step is to decide upon the wheel, work, and traverse speeds, and the amount of in-feed that will give the surface qualities desired at the highest rate of production possible and with a minimum of wheel wear. The natural impulse of the operator is to demand a table of speeds and feeds for grinding, such as he would use if he were operating a lathe, planer, shaper, or milling machine.

Many attempts have been made to draw up such tables—but they simply do not work in practice. Why they don't should be evident from the foregoing description of the factors that enter into the grinding operation.

Although the effect of changing any one of these factors—work speed, wheel speed, traverse speed, and in-feed—can be more or less accurately predicted, changing two or more of them simultaneously greatly complicates any attempt to predetermine the resulting action. Add to this the effect of the machine condition and the temperament, touch, and general skill of the operator, and it is evident that the selection of speeds and feeds depends upon so many factors, some of which are intangible and often fluctuating for no apparent reason, that no hard and fast tabulation or rigid analysis can be established. The best that an operator can do is to keep in mind the fundamental factors that affect wheel action, and to experiment in varying each until he secures the results he wants.

In general, it can be said that for fine grinding, the wheel should operate at speeds close to the upper recommended limit, that is, about 5000 surface feet per minute for hard, straight, vitrified wheels; and 6500 surface feet per minute for hard, straight, organic bond wheels. For ultra-finish grinding, 3000 surface feet per minute is the maximum.

Work speeds for most ferrous metals and hard alloys run from about 60 to 100 surface feet per minute. In grinding out-of-balance pieces, such as crankshafts, the speed must be kept below the point where vibration results.

Finishing cuts should be taken at lower work speeds than roughing cuts. Thus, while the rough-grinding of automotive cams is usually done at from 15 to 30 surface feet per minute, for finishing cuts the work speed is reduced by half. Form grinding by the direct in-feed method, where fillets or other forms of the wheel face must be maintained, calls for much lower work speeds than would otherwise be needed. At the lowest extreme is thread grinding, for which work speeds as low as 2 to 6 surface feet per minute are used.

For fine grinding, the traverse rate should also be slow. Thus, for a roughing cut, the wheel might well traverse as much as—but not more than—three-quarters of the width of the wheel face per revolution of the work. For an extremely high finish, 1/4 inch or even less per revolution of the work would be required. For ordinary good commercial finishes, that is to say a surface quality of about 6 micro-inches r.m.s., the traverse should not be more than one-half the width of the wheel face per revolution.

It is important that the traverse should never allow the wheel to pass off the work more than one-fourth of the wheel width, for the resulting increase in unit pressure, due to the decrease in contact area, is likely to taper the work ends. For accurate work, it is essential that all slack in the traverse should be taken up to prevent long dwell at the ends of the work, as this would cause the ends to be ground under size and the wheel to glaze.

In fine grinding, the roughing cut with any wheel may remove from 0.001 to 0.0005 inch of material, and for the finishing cuts, from 0.0002 to 0.000005 inch of material. For the finishing cut with the last of two or more wheels, the in-feed should seldom be more than 0.0003 inch.

Actual Procedure in Starting a Grinding Operation

Having made the tentative selection of speeds and feeds, the next step, of course, is to bring the wheel and the work into contact. This should be done with great care, and only when both wheel and work are in motion and when there is a copious flow of coolant at the point of contact.

If the wheel is brought into contact with the work suddenly, it is likely to make the wheel-spindle spring, with the result that the wheel will bounce against the work and produce intermittent burned spots. These burns may not be visible, but after the piece has been in use a short time, spalls or blisters are apt to appear. In many kinds of armament, the development of such flaws in service would be serious in the extreme.

No matter how carefully and intelligently the wheel is selected for a job, more than likely it will be observed after a few minutes of operation that it is not acting exactly right. It may be acting too hard or too soft. Don't assume that the wrong wheel was selected and lose time by shutting down the machine while a wheel of different grade is sent for, placed on the machine, balanced, trued, and balanced again.

Try adapting the wheel to the job in the light of what you know about grinding action, as set forth earlier in this article. Thus, if the wheel loads, glazes, or does not cut freely, try increasing the work speed slightly, while keeping all other conditions the same as before. The wheel will act softer. But if it is not yet soft enough in action, increase the work speed still more.

If a still softer action is needed, the wheel speed may be reduced, the traverse increased, and the in-feed increased, or the wheel dressed more openly. However, since slow traverse and slight in-feed are essential for really fine surfaces, it is best to leave these alone, if they were correctly set at the start, and do the juggling with the wheel and work speeds. Obviously, if the wheel acts too soft, the opposite procedure would be called for.

It is evident that with four movements that can be changed, each in many different amounts, the operator has considerable latitude in which to manipulate the operation in order to obtain the wheel action desired.

Sometimes, in striving for very fine surface finishes, it is possible to resort to a procedure that is probably not used so often as it might be—that is, to change the direction of work rotation. Instead of the surface of the work and the grits on the wheel face moving in opposite directions at the point of contact, they thus are moving in the same direction, although of course the grits are moving much faster than the work so that there is a cutting action.

In one case where exceedingly fine finish was required, no manipulation of the wheel seemed to give the desired result, but changing the direction of work rotation proved successful. The reason for this is uncertain, but it doubtless has to do with the fact that, with this method, the size of the chip is smaller.

Sometimes, too, grinding action can be improved by "doctoring" up the wheel face. One example of this was demonstrated in a shop grinding airplane piston-pins with a 180-grit wheel. The resulting surface was so rough that it was expensive to lap to the required smoothness. In spite of this, the order went out that the production rate must be greatly increased and the surface quality at the same time materially improved. Since fine grinding takes time, this seemed like an impossible job.

The problem was finally solved by an abrasive engineer, who painted the face of the grinding wheel with a lapping compound composed of 800-grit aluminum-oxide abrasive grain in a soluble oil vehicle. The resulting surface was so good that inspectors maintained it was of a roughness of zero micro-inches, r.m.s.—undoubtedly a considerable exaggeration. It was, however, good enough, and the subsequent lapping operation was eliminated.

* * *

New Method of Heating Non-Metallic Substances

Almost any non-metallic material can be heated uniformly throughout in a very few minutes by the use of the Thermex high-frequency heating equipment made by the Girdler Corporation, Louisville, 1, Ky. Among the materials that can be heated in this manner are plywoods, plastics, cellulose, paper, textiles, powders, felts, ceramics, rubber, etc. Because the equipment developed makes it possible to increase production and improve the quality of plastics with existing press and mold equipment, it is considered especially important for molded plastic operations. The heating equipment is available in a wide variety of sizes, from very small to extremely large. The types of machines best suited for use in molding plastics have single-knob control and are semi-automatic. A skilled workman is not required.

What are the Causes of War Production Letdown?

A Statement by J. F. LINCOLN, President
Lincoln Electric Co., Cleveland, Ohio

The statement by Secretary Knox regarding decreased war production is of tremendous importance to every American. The reasons for this decrease, ascribed by the Secretary, however, are far from convincing.

War production, or any other production, will increase under encouragement and decrease under discouragement. It is discouragement which is now reducing production. The policy of Government through renegotiation, through the encouraged philosophy of output limitation, is the cause of the reduction. It has been obvious to the expert from the first.

You cannot penalize efficiency, as is being done by renegotiation and the present tax program, without losing it. You cannot reward slovenly incompetence, as is now being done, without getting it. Washington has control, and Washington must take the blame for our production lapse.

* * *

Important Savings in Punch and Die Materials

A test run in which several hundred sheet-metal airplane parts were formed on a drop-hammer equipped with a newly developed type of all-plastic punch and a Kirksite die was recently made at the Curtiss-Wright plant in Buffalo. The test was termed by the company officials "highly successful." It is said that a punch and die of the type described can be produced at a saving of at least 75 per cent of the tooling labor required to build an all-metal die, in addition to the savings in scarce metals.

The plastic punch saves three-fourths of the time formerly spent in making the punch, because of the fact that it can be shaped to a perfect fit with the die in a single operation. The die is heated to approximately 370 degrees F., and the plastic punch, already roughly shaped, is pressed into the heated die. The pressure and heat makes the plastic flow, and the punch becomes an exact counterpart of the die without any machining.

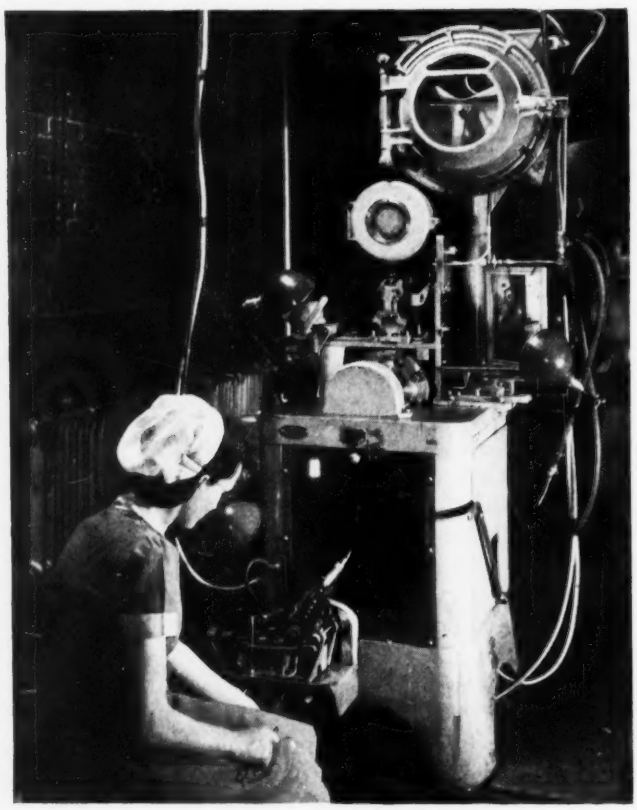
Another important advantage gained when this type of punch is used for forming sheet-metal parts is that it eliminates the use of the rubber pads and strips formerly employed. If the punch wears, it can be "dressed" by simply heating the Kirksite die and again pressing the plastic punch into it. Used punches can be reclaimed, so that no material is wasted.

Automatic Machine for Seating Foil Disks in Detonator Cups

A machine that does the work of approximately seventy-five workers has been developed by engineers of the Aluminum Seal Co., New Kensington, Pa., for use in Government arsenals. Called a foil-disk assembly machine, the unit is employed on loading lines for seating foil disks in detonator cups.

Previous to the development of this machine, disk seating was accomplished by laborious hand methods. The tiny foil disks, which measure less than 1/4 inch in diameter, were gaged by a micrometer to insure the seating of only one disk to a cup, and then placed by means of hand tweezers in the cups. Seating was done through the use of a small hand press.

In the machine, the detonator cups are placed in the hopper at the top, from where they pass automatically into a feed chute and from there to a transfer punch which transfers the cups, five at a time, into a seating block on an intermittent turret wheel. The turret carries the cups to a die, which blanks out the foil disks and pushes them to the bottom of the cups. The foil used for these disks is coated on one side with a thermo-plastic adhesive and is fed automatically through the die. A vacuum shoe under the seating block insures retention of the disks and permits the punch to return to its original position without the disk. Further revolution of the turret takes the detonators to a hot punch station, which "heat seals" the disks to the bottom of the cups.



Automatic Machine Developed to Blank and Seat Foil Disks in Bottom of Detonator Cups Fed from Hopper

After the seating operation, the detonator cups pass to the next station, where they are released and drop to an automatic inspection unit. At this point, the cups are pulled out of the inspection turret by vacuum and drop into a bin at the bottom of the machine. In the event that the disks are not properly seated, they are not ejected by the vacuum plunger, but are carried around in the turret and drop into a box.

Besides materially speeding up seating operations, the new machine eliminates one of the chief hazards that formerly accompanied the loading. "Heat sealing" by machine insures perfect adherence of the disk to the cup and does not permit the powder to seep underneath the disk. The results obtained indicate a marked decrease in the number of cups rejected.

* * *

Induction-Hardened Tank Transmission Parts Wear Three Times Longer

According to information obtained from the Ohio Crankshaft Co., Cleveland, Ohio, originator of the Tocco process of induction heat-treatment, induction-hardened 26-inch bevel-gear shafts and 30-inch drive sprockets used in English tanks of the Eighth Army in North Africa have lasted three times longer than the shafts and sprockets formerly used. As is well known, the general conditions in North Africa are hard on mechanized equipment, since grit and sand are constantly encountered.

Furthermore, it is stated that these parts were hardened by this process at a 75 per cent saving, compared with former costs. The latter statement is made on the authority of G. E. Miller, chief engineer of the Buckeye Traction Ditcher Co., Findlay, Ohio, in which plant the induction-heating process has been regularly used in the manufacture of these tank parts.

On the shaft, three areas are induction-hardened—the spline section and two needle bearing races. The spline area extends about 8 inches along the shaft, which has a diameter of 1 15/16 inches. The hardening is continuous; the heating and water quenching for each piece requires sixty-six seconds. A hardness of from 59 to 61 Rockwell C is obtained.

On each side of the spline, there are two 1 1/2-inch roller-bearing races, which, after having been induction-hardened, also have a hardness of from 59 to 61 Rockwell C. The depth of the hardness is 1/8 inch.

TOOL-TIPPING PROCEDURE—1
Brazing—1

Low-Temperature Brazing

This process is especially adapted to the requirements of high-speed steel.

Apparatus—An oxy-acetylene welding torch. A vise or jig in which to hold the tool in a convenient position.

Material—A silver brazing alloy shim of proper thickness, usually 0.003 to 0.008 inch, with a melting point of 1175 degrees F. maximum. A flux of a type that will dissolve oxides found on high-speed steel, and that will be fluid and active at brazing temperature. A good grease solvent.

Procedure for Hardened High-Speed Steels—

1. In joining an inserted tip to a shank, machine or grind a recess in the shank to match the tip.

2. Make sure that the surfaces of both recess and tip are fairly smooth. A milled surface or equivalent is satisfactory.

3. Clean all surfaces to be brazed with a good grease solvent.

4. Place the shank in the vise or jig with the recessed end projecting.

5. Coat the recess and the tip with flux.

6. Place the shim of silver brazing alloy on the entire recessed surface to be brazed.

7. Place the tip on the shim.

8. Apply heat with the oxy-acetylene torch. The flame should be neutral or slightly reducing.

9. Direct the flame to the under side of the shank below the recess, moving the flame back and forth to distribute the heat evenly. Heat the shank until it becomes a barely visible dull red.

10. Withdraw the flame to a greater distance from the work and continue heating until the brazing alloy melts, keeping the temperature as low as possible in order to avoid drawing the temper from the tip.

11. Make sure the alignment of the tip is correct.

12. Press the tip firmly into place. Maintain the pressure until the brazing alloy has solidified.

13. When the brazing alloy has solidified, as determined by eye, immerse the tool in oil long enough to set the braze, then cool in air. The hardness along the cutting edge should be comparable with that of solid hardened high-speed steel tools.

Procedure for Butt Joints, etc.—In joining a tip to a shank when a notch is not used, such as in the case of a butt joint, the procedure is similar, except that additional care must be taken to make sure that the alignment is accurate.

Tool-Holders

Tool-holders are particularly useful for high-speed steel tools, from a conservation standpoint, in sizes below 1/2 inch. This is because the various brazing and welding methods of tipping are not economical for sizes under 1/2 inch.

Further details, including sizes, types, and applications of tool-holders, can be obtained from manufacturers.

Compiled by Tools Division War Production Board

TOOL-TIPPING PROCEDURE—2
Brazing—2

High-Temperature Brazing

This method is used for tipping with annealed high-speed steel.

Apparatus—A high-heat furnace of the type used for hardening solid high-speed steel tools, or for brazing tungsten-carbide bits; it is advantageous, although not necessary, to have the furnace of a type in which the heat can be localized on the end of the tool. Also, a preheating furnace is useful; but if not available, the required preheat may be applied in the cooler portions of the high-heat furnace.

Brazing with Copper

Material—Copper shims 0.003 to 0.005 inch thick. Brazing flux suitable for brazing with copper. A good grease solvent.

Procedure for Brazing with Copper—

1. Machine or grind a recess in the shank to match the tip. Make sure that the surface of the tip to be brazed is fairly smooth. A milled or ground surface is satisfactory.

2. Remove all grease and dirt with the solvent.

3. Coat the tip and the recessed end of the shank with copper type brazing flux.

4. Place the shank in the furnace and heat until the flux flows freely. Maintain a neutral or slightly reducing atmosphere.

5. Remove shank and fit the copper shim into the recess.

6. Fit the tip on the shim.

7. Preheat the assembled tool to about 1600 degrees F. in the preheating furnace or in the cooler portion of the high-heat furnace.

8. Transfer the tool to the high-temperature furnace and hold it at the proper quenching temperature for the grade of high-speed steel (2200 to 2350 degrees F.) until the tip has soaked out. Soaking time should be kept to a minimum to prevent grain growth.

9. Since the melting point of copper is 1980 degrees F., the copper shim will have melted and spread over the interfaces. Withdraw the tool.

10. Adjust the alignment.

11. Press the tip firmly into place to squeeze out the excess copper and flux.

12. As soon as the copper has solidified, quench the tipped end in oil until the temperature has dropped to below 200 degrees F.

13. Temper the tool at 1000 to 1050 degrees F.

Brazing with Ferro-Alloy Cement

Material—Ferro-alloy cement, copper sulphate, sulphuric acid.

Procedure with Ferro-Alloy Cement—

1. Prepare a flat surfaced recess for the tip. The surfaces to be joined should be fairly smooth. Milled finish or equivalent is satisfactory.

2. Clean surfaces with grease solvent.

3. Prepare a solution of 3 ounces of copper sulphate and 10 drops of concentrated sulphuric acid, dissolved in one pint of water. With this solution, paint the surfaces to be joined.

4. While the surfaces of the recess are still moist, spinkle over them a layer of commercial ferro-alloy cement. Smooth out the layer so that it is flat and about 1/32 inch thick.

5. Press the tip firmly into the recess.

6. Set the tool aside for an hour or more. This will affix the tip securely enough to permit handling.

7. Preheat the tool to about 1600 degrees F. in the preheating furnace or in the cooler portion of the high-heat furnace.

8. Transfer the tool to the high-temperature furnace and raise it to the quenching temperature proper for the grade of high-speed steel involved (2200 to 2350 degrees F.).

9. Soak out the tip, but keep the soaking time to a minimum.

10. Withdraw the tool and press the tip into the recess to squeeze out excess cement, using foot-treadle or tongs.

11. Check the alignment.

12. When the cement has solidified, quench the tool in oil or air until the temperature has dropped to below 200 degrees F.

13. Temper the tool at 1000 to 1050 degrees F.

Compiled by Tools Division War Production Board

The Right Kind of Management-Labor Relations

Recently, the Walker-Turner Co., Inc., Plainfield, N. J., arranged a get-together of all employes of the company at which service pins were given to a large number of the employes, both in the shops and offices, for five, ten, fifteen and twenty years of service.

When the company had performed its part of the ceremony, G. L. Williams, factory superintendent, presented on behalf of the employes of the company a plaque to Ernest T. Walker and William B. Turner, chairman of the board and president, respectively, of the company. This plaque had been purchased with funds raised by subscription among the men and women in the shops and offices, and bore the following inscription:

"Presented to Ernest T. Walker and William B. Turner—It is with sincere appreciation of the friendly relationship and many considerations shown to us that this tangible expression of good will was planned and presented by the employes of Walker-Turner Co., Inc.—June 19, 1943."

* * *

College Men in Industry

The General Electric Co. and associated companies employ over 9200 college graduates—approximately 5 per cent of all the employes of the company. These college graduates, men and women, come from 325 domestic colleges and from foreign educational institutions in thirty-four different countries. The engineering graduates predominate, numbering about 6000. In addition, there are 500 with degrees in physics, chemistry, or science; nearly 800 with liberal arts degrees; and more than 1000 with degrees in business administration.

Copper Shortage is Becoming Serious

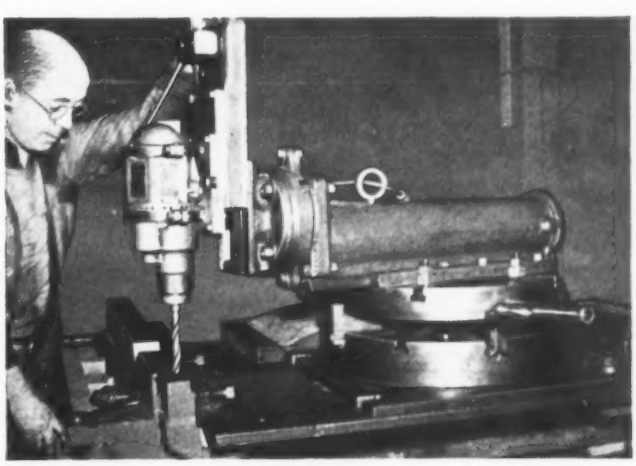
The United States depends upon scrap as a source for approximately 40 per cent of its copper. Much of this scrap is usable by remelting, without further refining. Copper wire, for example, is almost pure copper, and scrap wire can be used in place of virgin copper. The flow of this almost pure scrap is diminishing so rapidly that the gap must be filled by other less pure grades, which must be refined before they can be used. Among these grades are "refinery brass" and "copper-bearing" materials. The War Production Board appeals to industry for additional copper, brass, and bronze scrap, emphasizing that in December, 1942, the scrap refineries received only 4800 tons of the less pure grades requiring refining—enough to enable them to operate at one-fifth capacity.

The output of virgin copper from mined ores cannot meet the demand because of the shortage of workers. As in the steel industry, the use of scrap makes possible speedier production, as well as labor and transportation savings.

The War Production Board hopes that industry in 1943 will achieve an increase of over 60 per cent in the flow of copper, brass, and bronze scrap. This would result in capacity operation of the nation's scrap copper refineries. From the 1,625,000 tons of scrap collected, 1,000,000 tons of copper can be produced to be used in the war effort.

* * *

The war has upset many peace-time traditions, one of which is that women are not suitable for supervisory jobs in machine shops. The N. A. Woodworth Co., Ferndale, Mich., has helped to upset this tradition by having nearly 100 women in its employ who have replaced men as production line "leaders."



A Convenient Sliding-head Drill Built up from Machine Tool Parts at the Plant of the Simmons Machine Tool Corporation. It Consists Primarily of a Large Lathe Chuck, a Shaper Ram, and an Electric Drill

New Trade Literature

RECENT PUBLICATIONS ON MACHINE SHOP EQUIPMENT, UNIT PARTS, AND MATERIALS

To Obtain Copies, Fill in on Form at Bottom of Page 209 the Identifying Number at End of Descriptive Paragraph, or Write Directly to Manufacturer, Mentioning Catalogue Described in the August Number of MACHINERY

Atomic-Hydrogen Welding

GENERAL ELECTRIC CO., Schenectady, N. Y. Bulletin GEA-823F, "Atomic - Hydrogen Arc - Welding Equipment for Hard-to-Weld Metals"; GET-1062, "How to Adjust and Operate the Atomic-Hydrogen Electrode - Holder"; GEA - 3884, "How to Repair Tools and Dies by Atomic-Hydrogen Welding"; GES-3116, "The Inside of Atomic-Hydrogen Arc Welding." 1

Lathes

SOUTH BEND LATHE WORKS, South Bend, Ind. Catalogue 9-C, on South Bend precision bench and base type lathes. Catalogue 100-C, describing the entire line of South Bend engine lathes, tool-room lathes, and turret lathes. Catalogue 901, covering South Bend Series 900 and 1000 turret lathes. 2

Carbide Tools

NEW ENGLAND CARBIDE TOOL CO., 60 Brookline St., Cambridge, Mass. Catalogue on the finish-ground standard carbide-tipped tools made by this company. A wall chart giving dimensions, forms, clearances, and prices is also available for tool-rooms and purchasing departments. 3

Design for Arc Welding

HOBART BROTHERS, CO., Hobart Square, Troy, Ohio, has started a new data service, in loose-leaf form, entitled "Practical Design for Arc Welding," the object of which is to provide time-saving suggestions for the economical design of "change-overs" or new products. 4

Milling Equipment

PLAN-O-MILL CORPORATION, Royal Oak, Mich. Bulletin 3, on form and thread milling machines with complete feed control. Bulletin 5, on Plan-O-Mill with hydraulic feed and speed control for precision-threading and form-milling of large and cumbersome parts. 5

Cleaning Industrial Respirators, Goggles, Etc.

OAKITE PRODUCTS, INC., 26 Thames St., New York City. Field service report on the cleaning, care, and maintenance of such industrial equipment as respirators, goggles, face and eye shields, welding helmets, etc. 6

Automatic Screw Machines

THOMAS B. GIBBS & CO., DIVISION OF THE GEORGE W. BORG CORPORATION, Delavan, Wis. Catalogue illustrating and describing the Model 375 automatic screw machine for small parts (bar capacity up to 3/8 inch, turning length up to 2 1/2 inches). 7

Socket Screws and Steel Belt Lacing

BRISTOL CO., MILL SUPPLY DIVISION, Waterbury, Conn. Bulletins 849 and 850, giving prices on multiple-spline type and hex type socket screws, respectively. Bulletin 773, giving prices, sizes, etc., on steel belt lacing. 8

Non-Ferrous Castings

HOWARD FOUNDRY CO., 4908 Bloomingdale Road, Chicago, Ill. Bulletin on the company's facilities for making magnesium, aluminum, bronze, brass, and other non-ferrous castings. 9

Angle Computers

ANGLE COMPUTER CO., 5720 Melrose Ave., Los Angeles, Calif. Bulletin 2, illustrating and describing the Studler angle computer, designed to simplify the lay-out of die work, the survey of castings, and the inspection of precision-machined parts. 10

Welding Chart of Castolin Eutectic Welding Alloys

EUTECTIC WELDING ALLOYS CO., 90 Worth St., New York City. Welding chart giving physical properties of Castolin eutectic low-temperature welding alloys, and procedure in welding different kinds of metals. 11

Sine Checking Equipment

TAFT-PEIRCE MFG. CO., Woonsocket, R. I. Booklet on sine checking equipment, including instructions on the application of the sine bar and tables of constants for the 5-inch sine bar, together with conversion factors. 12

Cylindrical Finishing Machines

HAMMOND MACHINERY BUILDERS, INC., 1619 Douglas Ave., Kalamazoo, 54F, Mich. Bulletin 502, descriptive of Hammond cylindrical grinding, polishing, and buffing machines, adapted for use either with wheels or abrasive belts. 13

Deep-Hole Drilling Machines

MOREY MACHINERY CO., INC., 410 Broome St., New York City. Circular 743, descriptive of the Morey deep-hole drilling machine, made in duplex and single spindle models, equipped for both hydraulic and mechanical feed. 14

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RELIANCE ELECTRIC & ENGINEERING CO., Ivanhoe Road, Cleveland, Ohio. Circular entitled "What Am I Doing?" showing the part the Reliance electric motor is playing in furthering the war effort....16

Safety Manual

MEYER SHEET METAL MACHINERY CO., Los Angeles, Calif. Machinery Maintenance and Safety Manual for power presses, press brakes, shears, spot-welders, and plate and sheet-metal fabricating equipment....17

Metal Products

AMPCO METAL, INC., Milwaukee, Wis. Engineering Data Sheets Nos. 112 and 113, outlining Ampco manufacturing facilities and listing Ampco cast, wrought, and machined products....18

Clutch-Head Screws

UNITED SCREW & BOLT CORPORATION, Chicago, Ill. Catalogue descriptive of a new type of clutch-head screw, designed to be operated by an assembly bit or a standard type screwdriver....19

Spun-End Tubes

WOLVERINE TUBE DIVISION OF CALUMET & HECLA CONSOLIDATED COPPER CO., Detroit, Mich. Catalogue E-1, descriptive of the new process of tube spinning developed by this company....20

Hand-Scraped Surface Plates

BARCO SCRAPING CO., 1975 E. 65th St., Cleveland, Ohio. Circular entitled "Cut Inspection Time—Reduce Production Losses by Checking with Barco Meehanite Hand-Scraped Surface Plates."....21

Hand-Stoned Cutting Tools

BEHR-MANNING CORPORATION, DIVISION OF NORTON CO., Troy, N. Y. Circular giving definite instructions on how to produce the best cutting edge on tools by hand-stoning....22

Duplicating Equipment

TURCHAN FOLLOWER MACHINE CO., 8249 Livernois Ave., Detroit, Mich. Catalogue on follower machines for duplicating any work produced by standard or special machine tools....23

Adjustable Cutters

ROBERT H. CLARK CO., 3424 Sunset Blvd., Los Angeles, Calif. Circular C-7, descriptive of the construction and application of the Clark three-blade adjustable hole-cutters and surface-facers....24

Gear-Cutting Tools

MICHIGAN TOOL CO., 7171 E. McNichols Road, Detroit, 12, Mich. Bulletin 531, entitled "Here's How to Know How on Gear-Cutting Tool Conservation."....25

Templet Dies

ALGOMA PRODUCTS, 3080 E. Outer Drive, Detroit, 12, Mich. Bulletin T-43, describing the advantages and construction of Algoma templet dies, which are interchangeable and can be easily altered for design changes....26

Pipe Templets for Welded Fittings

AIR REDUCTION, 60 E. 42nd St., New York City. Booklet describing how to fabricate fittings for welded piping installations by means of flame-cutting and welding....27

Reclaiming Carbide-Tipped Cutters

CARBOLOY COMPANY, INC., 11147 E. Eight Mile Road, Detroit, 32, Mich. Bulletin GT-157, describing how to reclaim carbide-tipped cutters and worn-out high-speed steel cutters....28

Punching and Notching Equipment

WALES-STRIPPIT CORPORATION, 345 Payne Ave., North Tonawanda, N. Y. Bulletin G, describing the features of design of Wales punching and notching units....29

Safety Handwheels

GIBBONS MFG. CO., 11 Gordon St., Worcester, 4, Mass. Folder descriptive of a new safety handwheel for wood- or metal-working machinery....30

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Hydraulic Surface Grinders

HILL ACME CO., 6400 Breakwater Ave., N.W., Cleveland, 2, Ohio. Bulletin H-V-3, illustrating and describing Hill open-side, heavy-duty hydraulic surface grinders. 31

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BROWN INSTRUMENT CO., 4485 Wayne Ave., Philadelphia, Pa. Bulletin 87-1, on New-Matic Time-Pattern Controllers for temperatures, pressures, flow, etc. 33

Hydraulic Cylinders

HANNA ENGINEERING WORKS, 1765 Elston Ave., Chicago, Ill. 32-page catalogue containing data on hydraulic cylinders, of special interest to engineers. 34

"Wet-Belt" Machining

PORTER-CABLE MACHINE CO., Syracuse, N. Y. Catalogue describing the new precision machining method of "wet-belt" machining and the results obtained. 35

All-Angle Vises

BERCO MFG. CO., 429 W. Superior St., Chicago, Ill. Folder descriptive of the Hilco all-angle vise with "Driv-Wheel" movement. 36

Solenoids for Foot-Operated Spot-Welders

HERCULES ELECTRIC & MFG. CO., INC., 2416 Atlantic Ave., Brooklyn, N. Y. Circular on heavy-duty solenoids for foot-operated spot-welders. 37

Machine Tools and Accessories

DELTA MFG. CO., 606-H E. Vienna Ave., Milwaukee, Wis. 52-page catalogue of machine tools, woodworking production tools, and accessories. 38

Cylindrical Boring Machine

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RANSOME MACHINERY CO., Dunellen, N. J. Bulletin entitled "Positioning Pays," illustrating and describing welding positioners. 42

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ACME INDUSTRIAL CO., Department M, 200 N. Laflin St., Chicago, Ill. Publication dealing with light-wave measurements for precision work. 43

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TITEFLEX METAL HOSE CO., 500 Frelinghuysen Ave., Newark, N. J. Catalogue covering Titeflex all-metal flexible hose. 44

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Ring-Gage Holder

NORTHERN TOOL & DIE CO., 330 N. Albany Ave., Chicago, Ill. Circular of new type twin-ring gage-holder. 47

Pipe and Stud Extractors

REPS TOOL CO., INC., 82 Wall St., New York City. Folder on pipe, stud, and screw extractors. 48

Roller Bearings

BOWER ROLLER BEARING CO., Detroit, Mich. Bulletin entitled "Bearings for Victory." 49

To Obtain Additional Information on Shop Equipment

Which of the new or improved equipment described on pages 211-240 is likely to prove advantageous in your shop? To obtain additional information or catalogues about such equipment, fill in below the identifying number found at the end of each description—or write directly to the manufacturer, mentioning machine as described in August, 1943, MACHINERY.

No.	No.	No.	No.	No.	No.	No.	No.	No.	No.

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Detach and mail to MACHINERY, 148 Lafayette St., New York, 13, N. Y.

[SEE OTHER SIDE]

Shop Equipment News

Machine Tools, Unit Mechanisms, Machine Parts, and Material-Handling Appliances Recently Placed on the Market

Sheffield Micro-Form Profile Grinder

The Sheffield Corporation, Dayton, Ohio, has just brought out a "Micro-Form" grinder equipped with a pantograph and microscope by means of which work can be finish-ground to the required profile with a high degree of precision. With this equipment, the form or profile required can be produced directly from an enlarged-scale drawing, thus eliminating templets and much unnecessary labor and expense.

This new machine is especially suited for grinding both circular and flat form tools, templets, profile gages, cams, dies, etc., from hardened materials, including tungsten carbide. It can also be used for making enlarged 50 to 1 lay-out drawings of parts and for checking parts against lay-out drawings.

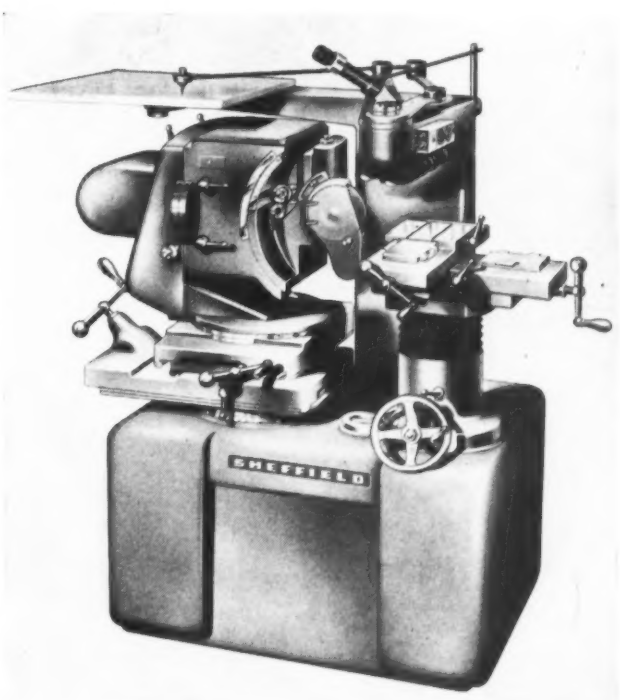
When profile grinding, a lay-out drawing made to a scale of 50 to 1 is placed on the drawing table of the precision pantograph, which has a microscope mounted on its short arm. Following the lines on the lay-out drawing from point to point with the pantograph stylus moves the microscope equipped with cross-hairs exactly on the line of the profile to be ground. The operator feeds the grinding wheel so that its cutting edge always works toward the point marked by the cross-hairs, which corresponds to the position of the stylus, but does not allow the wheel to go beyond the intersection of the cross-hairs.

An accuracy of 0.0003 inch is easily obtained in the grinding operation. Still closer limits can be held after the operator has become reasonably familiar with the machine. One of the advantages of this equipment is that the accuracy is in no way affected by wheel wear.

The grinding wheel can be set at any desired angle for feeding in any direction by means of the unusual arrangement of cross and circular slides. Other adjustments give the effect of a double universal joint. This permits the forming of any shape, no matter how intricate, and also makes possible the grinding of rake and clearance angles simultaneously with the form-grinding.

The head for holding the work is mounted on a column and is adjustable vertically. The compound table permits the work to be properly positioned both crosswise and lengthwise and to be locked in place for the grinding operation. By the use of precision blocks, set against the stops, and dial indicators mounted on each slide, the movement in either direction can be accurately controlled. This is especially advantageous when using the indirect method of working, where the table has to be moved more than once in grinding the profile.

The front table edge is exactly parallel with the table slots and table guide, and can therefore be employed in lining up the work. Once set, the slides are clamped one upon another. The grinder has a direct working range over an area of 0.400 by 0.400 inch in one setting, corresponding to the 1 to 50 ratio of the drawing.



Sheffield "Micro-Form" Precision Profile Grinding Machine

The drawing table is 22 inches square, and can be rotated in a horizontal plane, so that the starting line of the drawing can be made to coincide with the starting point on the work. The optical apparatus comprises a 30-power microscope and a revolving reticule consisting of a lens with cross-hairs.

Two tubular lamps, protected by insulated screens, are mounted on the upper bracket and focussed directly on the work. Another illumination arrangement, built into the base, provides a green-light background that accentuates the contours of the work and thus facilitates obtaining maximum accuracy. Separate switches control these lights.....51

To obtain additional information on equipment described on this page, see lower part of page 210.

Dayton Rogers Piercing Press with Automatic Control

The Dayton Rogers Mfg. Co., 2835 Twelfth Ave. S., Minneapolis, Minn., has developed a new type of piercing press that automatically goes through the required working cycle when a piece of work is placed in position for piercing. On completing the working cycle, the machine is locked until the pierced piece is replaced with a new one, when the operation is repeated automatically. Operation of the press by automatic electric control in this manner eliminates the hazards incident to manual tripping and facilitates safe operation at maximum production speeds.

This press is especially designed to insure a high degree of accuracy in the size and location of the pierced holes and to keep the initial cost of the tools at a minimum. With this press, it is possible to change the size and location of the holes in a given group of pierced blanks with a minimum expense and loss of time. Holes of any size from 0.015 to 1 1/8 inches in diameter, progressing in increments of 0.001 inch, can be pierced.

The press is available in two sizes having throat capacities of 12 and 14 inches and a maximum operating pressure of 15 tons. The slide stroke is 1 3/4 inches, and the ram has an adjustment of 2 inches. The shut height for the die space is 2 and 3 inches. Each press is completely self-contained, with an individual motor drive. The driven ram, which carries the die member, is located at the bottom of the press, while the stationary punch is located in the upper section.

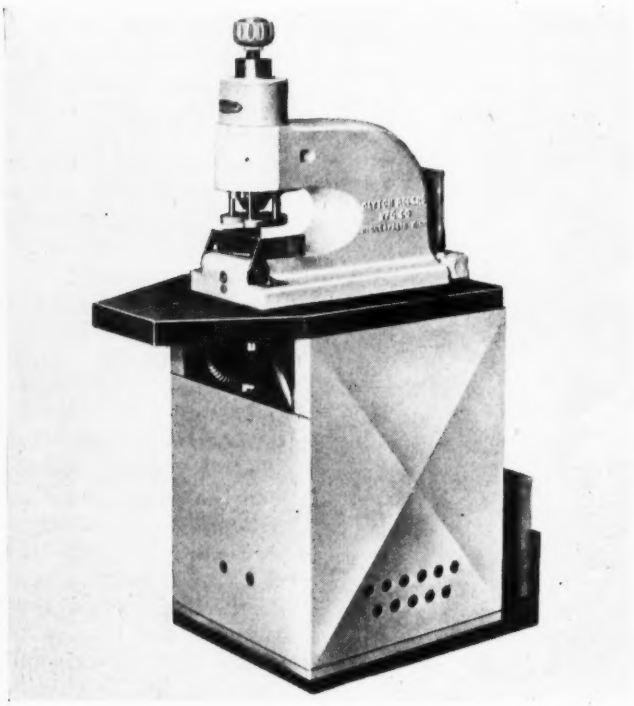
When the guard is removed for any reason, as for instance when changing tools, the power switch is automatically thrown out to prevent injury to the operator or damage to the machine. Each machine is provided with special cushion stripping mechanism mounted in the head. The presses are so designed that they can be conveniently grouped in circular formation to facilitate operation. 52

Snyder Automatic Machine for Milling Slots in Aircraft Cylinder Heads

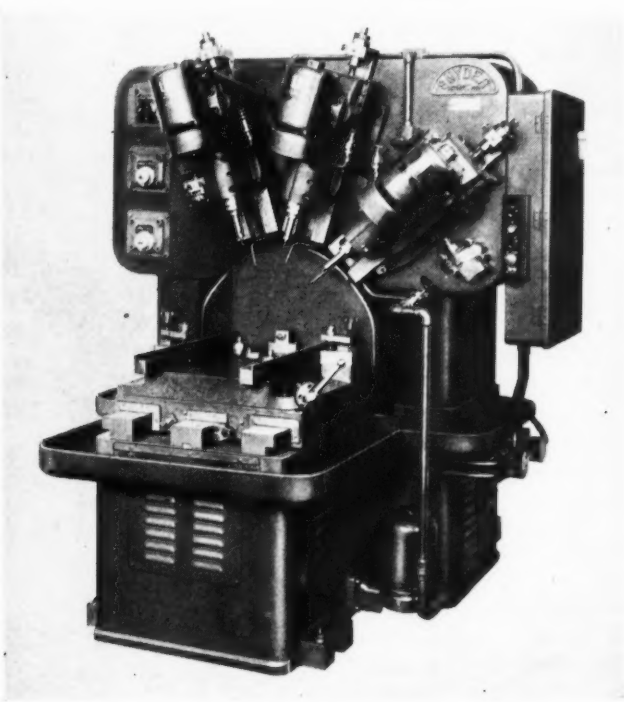
The problem of cutting slots for binder bars in forged aircraft cylinder heads has been solved by a special machine designed and built by the Snyder Tool & Engineering Co., Detroit, Mich. All three slots, which are angularly arranged on three "fin" sections of the cylinder head, are cut at one time, the work cycle being as described in the following: The cylinder head is placed on a master locating plate and clamped on the fixture table. The starter button is then pressed, causing the tools to advance into the work and feed to the required depth of 3/16 inch. When the full depth of cut is reached, the table automatically moves lengthwise, feeding the work against the tools for the required length of cut. At the end of the cut, the tools are automatically withdrawn, thus completing the cycle.

The finished part is now replaced by another part, which is clamped in its place. The starter button is then pressed, causing the cycle to be repeated, with the table moving in the opposite direction for the lengthwise cut. This brings the table back into its original position and eliminates the need for resetting the table between cuts.

Double-end straight-shank endmills are used for this job. Adjustment for wear is provided on each unit through micrometer screws. The spindles are of the high-precision, high-speed, ball-bearing type, and are driven by V-belts from individual dynamically balanced mo-



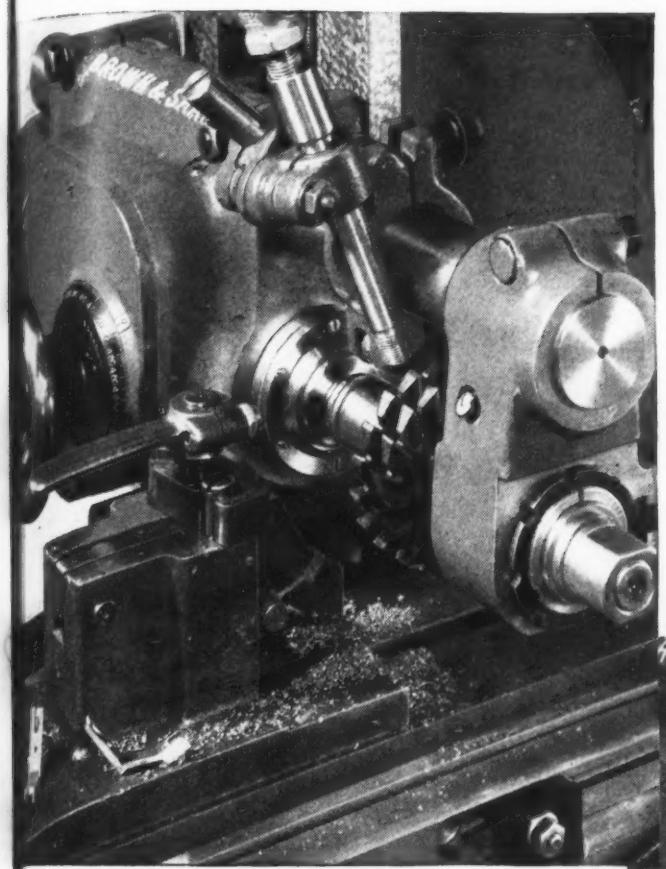
Piercing Press with Automatic Control Built by Dayton Rogers Mfg. Co.



Snyder Automatic Machine for Milling Binder-bar Slots in Cylinder Heads

To obtain additional information on equipment described on this page, see lower part of page 210.

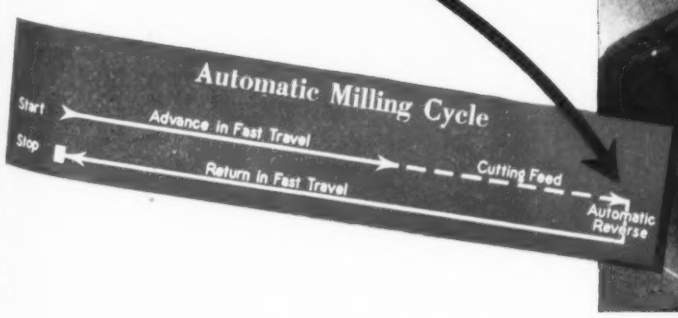
USE THE ACCURACY OF TABLE REVERSAL
— step up small parts milling on your No 000's

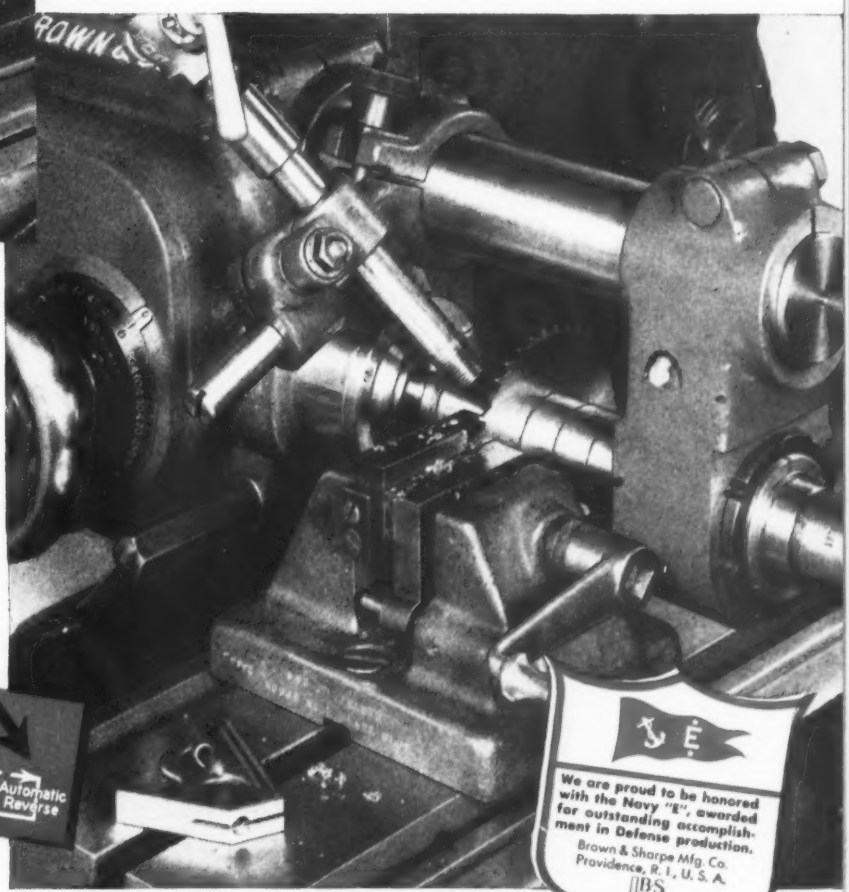


Consistent reversal of the machine table within an accuracy of .002" gives the equivalent of a positive stop. This is ideal for blind cuts where accurate table reversal is essential.

And — the precision adjustment of the table to position the work when setting up is a time-saving feature.

Take advantage of this accuracy of reversal on **every** job and reduce non-cutting time to a minimum





We are proud to be honored with the Navy "E", awarded for outstanding accomplishment in Defense production.
Brown & Sharpe Mfg. Co.
Providence, R. I., U. S. A.
BS

Make **full** use of the production possibilities of the No. 000 Plain Milling Machine for the rapid milling of small parts on a wide variety of materials.

DELIVERIES ARE GOOD
on New No. 000 Plain Milling Machines

BROWN & SHARPE

tors. Each spindle is operated by an individual hydraulic cycle arrangement. All three spindles are geared for simultaneous operation.

The fixture table is hydraulically operated by the transverse feed stroke, and rides on hardened and ground ways with a heavy center guide. The column of the machine carrying the three units also houses the piping and other hydraulic equipment. Coolant is supplied by a pump from a tank in the base. The three controls shown on the column are for controlling the feed of the tools and the forward and backward feed movements of the fixture table. 53

"Rotab" Tilting Faceplate for Checking Angles on Large Units

Large units can be checked for accuracy of all angles without disturbing the original clamping of the piece being measured through the use of a new development of the Machine Products Corporation, 6771 E. McNichols Road, Detroit, Mich. This device, known as the "Rotab," is designed to simplify and speed up the checking, as well as the machining operations on large fixtures, castings, patterns, or fabricated parts.

The faceplate to which the work is clamped can be rotated to any angle from the vertical to the horizontal, and even to a position 30 degrees beyond the horizontal in the opposite direction. The movement of the table is controlled by regulating wheels. Dials showing degree and minute graduations register the angular setting. A 10-inch sine bar is furnished to provide a greater degree of accuracy when required. The table can be locked in any position — radial or angular — and can also be disengaged to permit free rotation.

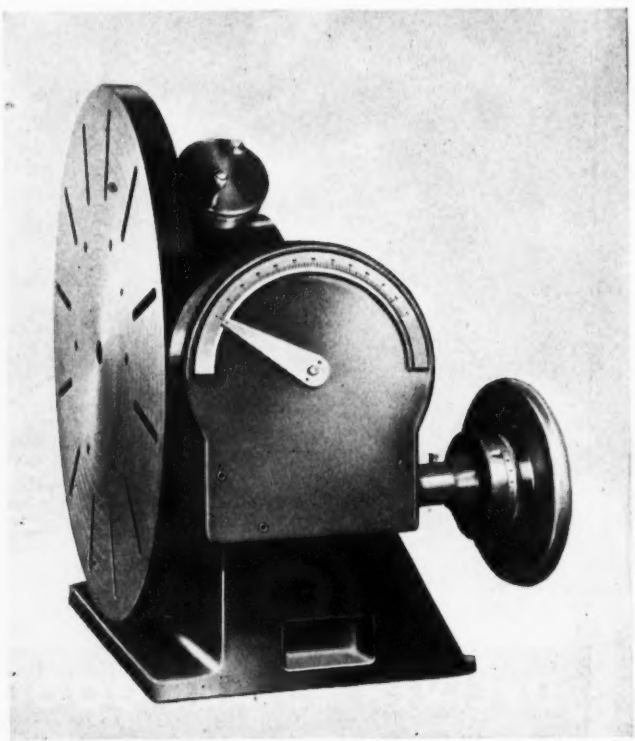
In addition to its use as a checking device, the "Rotab" can be employed as a fixture in boring-mill set-ups. The heavy-duty faceplate is 36 inches in diameter, and can be replaced by a sub-plate 18 7/8 inches in diameter when required for smaller work. The distance from the bottom of the base to the center of the main bearing is 20 inches; the over-all height to top of plate when in the horizontal position is 27 5/8 inches; and the size of the base, 20 1/2 by 27 1/8 inches. The weight is 1400 pounds. 54

General Electric Direct-Current Vertical Motors

A new line of direct-current vertical motors ranging from 40 to 200 H.P. at 1750 R.P.M. and in equivalent ratings at other speeds has been brought out by the General Electric Co., Schenectady, N. Y. The new motors, which are furnished for both constant and adjustable speeds, are designed for low-thrust, solid-shaft applications on pumps, machine tools, and marine auxiliaries. They are also desirable where floor space must be saved and gearing avoided.

The motors are of drip-proof construction, providing complete protection from dripping liquids and falling objects. Convenient fittings on both the upper and lower bearings simplify lubrication, and provision for the escape of excessive grease reduces the possibility of over-lubrication. A special bearing housing prevents grease from entering the motor and damaging the commutator and windings.

The cast-iron conduit box can be arranged for bringing the leads in

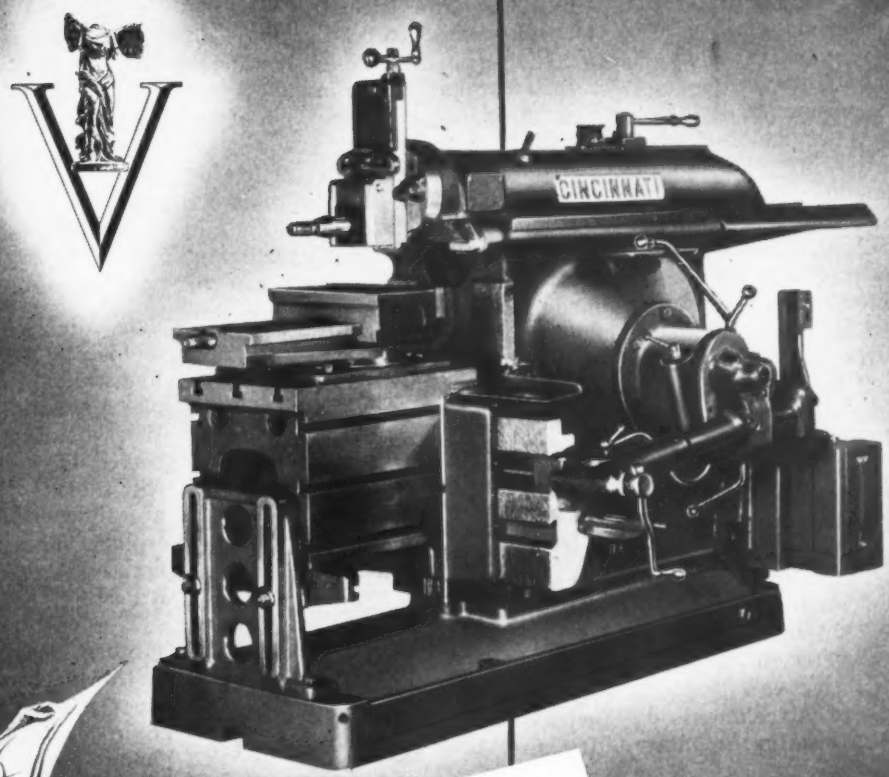


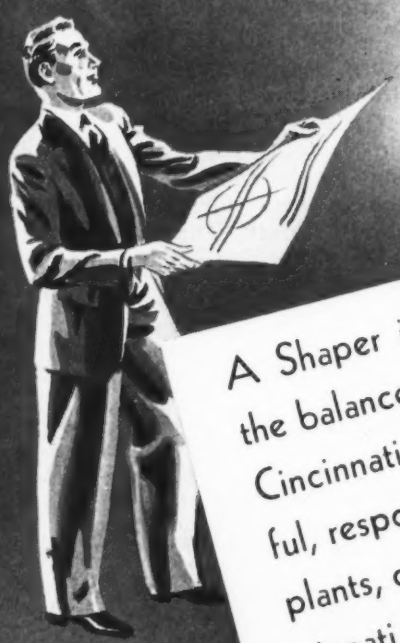
"Rotab" Faceplate for Checking Angles on Large Work

Direct-current Vertical Motor Built by General Electric Co.

To obtain additional information on equipment described on this page, see lower part of page 210.

Check Your CENTER of GRAVITY!





A Shaper is the center of gravity of the balanced tool room and die shop. Cincinnati Shapers are accurate, powerful, responsive. In batteries in the large plants, or singly in the small shop, Cincinnati Shapers give outstanding value

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THE CINCINNATI SHAPER CO.

CINCINNATI OHIO U.S.A.

SHAPERS BRAKES SHEARS

at the top, bottom, or either side. Two hand-hole covers, removable without the use of tools, permit quick and easy inspection of the commutator and brushes. The ring type base has an accurately machined rabbet and jig-drilled mounting holes, thus assuring permanent alignment. Sturdy lifting lugs facilitate installation. 55

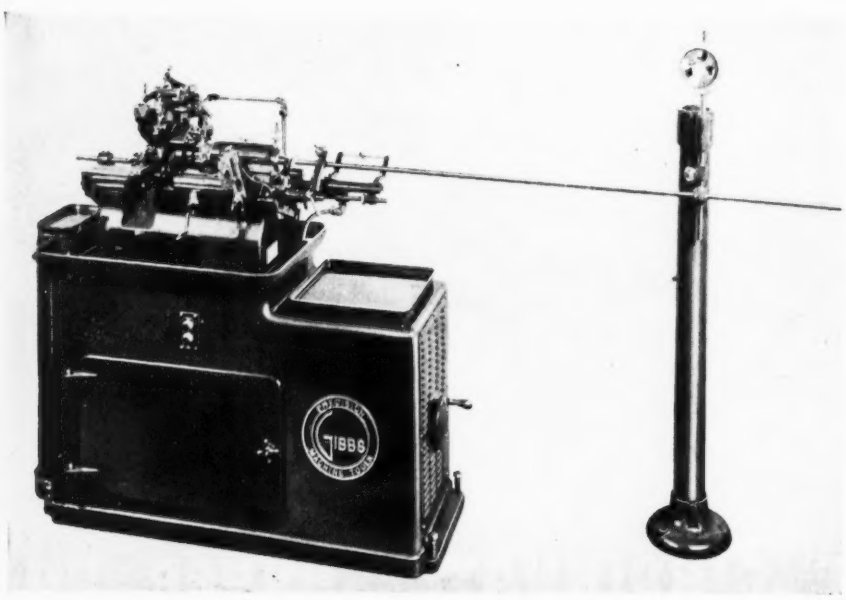
Gibbs Automatic Screw Machine

Thomas B. Gibbs & Co., Delavan, Wis., has announced to the trade a Model 375 automatic screw machine, designed to perform a wide variety of intricate operations at high speed in a single production cycle. This machine employs five single-point cutting tools, and is capable of performing a wide range of turning, forming, and knurling operations in the same production cycle. In addition, five specially designed attachments can be used to increase the capacity of the machine for drilling, counterboring, reaming, threading, and slotting.

The machine has a bar stock capacity of 3/8 inch, and is capable of turning parts with a maximum length of 2 1/2 inches. A stepless range of spindle speeds, from 1000 to 10,000 R.P.M., is controlled by means of an Allis-Chalmers Vari-Pitch speed-changer. All cutting tools are controlled by flat cams, equipped with both lateral and vertical micrometer adjustments. Small precision parts can be turned to a tolerance of 0.0002 inch on diameter and concentricity in one operation.

A full range of attachments is available that eliminate many second operations. They include a single-spindle drilling attachment for both positive and sensitive drilling of holes up to 3/16 inch in diameter with a stroke of 2 inches; single-spindle threading attachment capable of threading work up to 1/4 inch in diameter with a 2-inch stroke; two-spindle drilling and threading attachment for performing both operations in one camshaft cycle prior to cutting off the turned part; three-spindle attachment for spotting, drilling, and reaming; and slotting attachment.

Additional modifications can be made to permit the turning and hobbing of pinions in one production cycle. Attachments can also be furnished for both milling and cross-drilling the turned piece in the same turning cycle. 56



Automatic Screw Machine Placed on the Market by Thomas B. Gibbs & Co.

Thompson Automatic Profile Miller

A simple automatic profile milling machine, designed for the production milling of parts having irregular contours, is being manufactured by the Earl A. Thompson Mfg. Co., 1300 Hilton Road, Ferndale, Mich. The work is carried on a 14-inch rotating table which is hydraulically controlled by a simple cam-and-follower mechanism. Work-holding fixtures are positioned by a ground center hole in the table. The spindle and table are independently driven and controlled. The spindle has a selective speed range of from 127 to 3435 R.P.M.

Automatic Profile Miller Built by E. A. Thompson Mfg. Co.

The cutter-spindle, mounted on Timken bearings within the quill in the machine head, has a No. 40 taper nose. The quill has a silent chain drive and hardened helical change-gears that run in oil. Provision is made for a 6-inch vertical adjustment. The machine has a built-in pressure and gravity lubricating system. 57

Vacuum Chucking Equipment

Vacuum chucking equipment for use in grinding, polishing, sanding, or other operations on metal, glass, plastic, wood, or other materials, is being placed on the market by Leiman Brothers, Inc., PD-146 Christie St., Newark, N. J. The equipment consists of a vacuum pump with an automatic oil-feeding system, a vacuum relief valve, a tank with a cloth bag to prevent abrasive dust or chips from entering the pump, a hand release valve, and a chuck.

For holding work on a surface grinder table, for example, a flat chuck is used, which has its surface

To obtain additional information on equipment described on this page, see lower part of page 210.

Happy Landings

Accuracy promotes safety! Illustrated below is a battery of 3 Super Service Box Column Upright Drilling Machines in action in a well known western plant. These Machines are applied exclusively to the 2-diameter drilling of inner cylinder assemblies of Landing Gear Struts. Operations are on the "ears" of end fittings, where the adaptabilities and capacities of these Drills stand out to particular advantage in maintaining close accuracy and a high rate of output. Complete details on all features will be sent upon request.

THE CINCINNATI BICKFORD TOOL COMPANY

OAKLEY CINCINNATI, O.

ARMY E NAVY

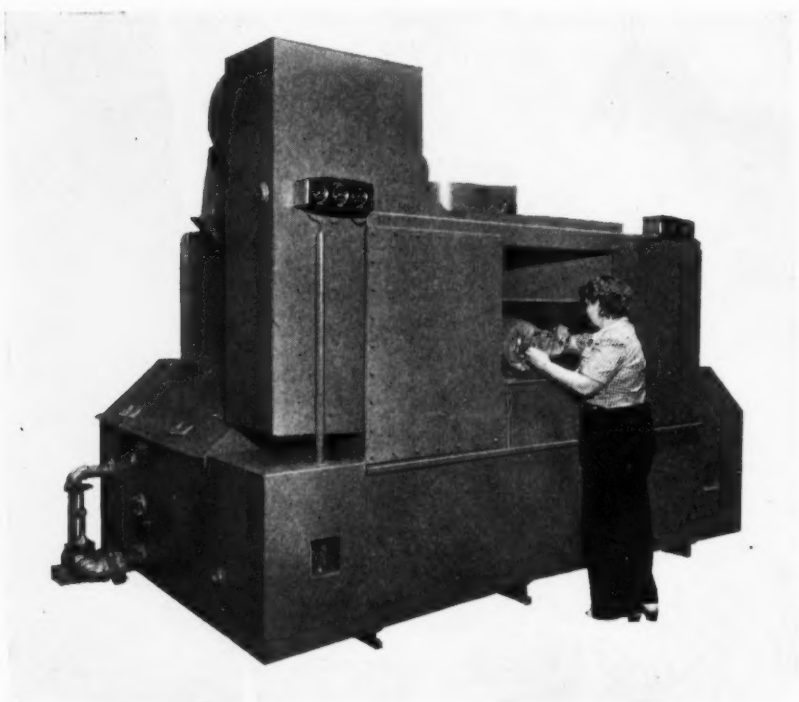
AWARDED SEPT. 10, 1942

covered with countersunk holes leading to a chamber connected to the vacuum pump line. Holes that are not required in holding a certain piece are covered by paper or pasteboard in order to utilize the full vacuum holding power. For holding work that rotates, as in the case of lathe work, a swivel air-tight joint is used to connect the chuck with the pump. The vacuum pump can be furnished in a number of sizes, as required by the size and weight of the work handled.....58

Segmented Type Cabinet Washing Machine

The Industrial Washing Machine Corporation, New Brunswick, N. J., is manufacturing a segmented type cabinet washing machine equipped with either a large mesh turntable or special fixtures which rotate slowly, depending upon the nature of the work to be cleaned. The housing surrounding the turntable is divided into various washing, rinsing, slushing, and drying compartments. The parts to be cleaned are placed either directly upon the mesh or on the fixtures. As the turntable rotates, it carries the work through the cleaning compartments and returns it to the same operator who does the loading. Production ranges from 1 1/2 to 7 1/2 square feet per minute.

With this new type machine, only one operator is needed; a floor space of only 10 1/2 by 6 1/2 feet is required; superior spray coverage is provided; and any of the cleaning detergents now on the market can be used. Machines of this type are being used for cleaning cylinders, gears, piston-rings, connecting-rods, pistons, machine castings, die-castings, rocker arms, and flexible metal conduits. 59

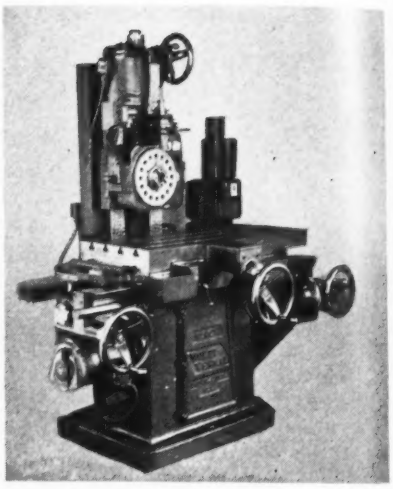


Segmented Type Cabinet Washing Machine Manufactured by the Industrial Washing Machine Corporation

Hack Heavy-Duty Model Multi-Versal Machine

A No. 10 heavy-duty machine that is especially adapted for machining work of complicated shapes such as characterize airplane parts, and that permits performing a sequence of operations of various kinds without disturbing the work, has just been added to the line of Multi-Versal machines manufactured by the Hack Machine Co., 1226 Harding Ave., Des Plaines, Ill. The high-speed range of this machine is suitable for jig boring, and the low-speed drive has a capacity for 8-inch face mills.

Spiral milling, gear-hobbing, universal boring-bar work, form tool



Hack Heavy-duty Multi-Versal Machine

generating, and internal and external thread milling can be performed by employing special or extra equipment developed for this machine.

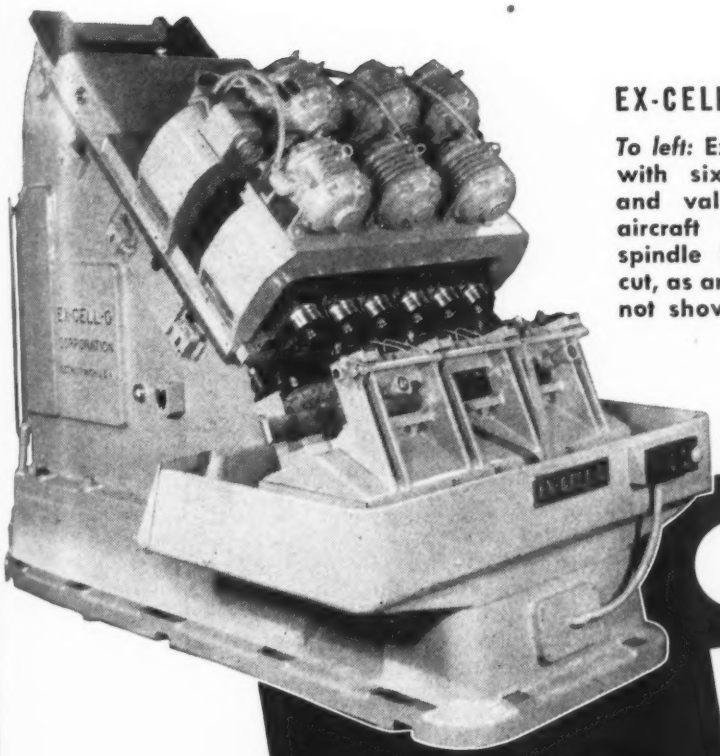
The master head is a self-contained horizontal milling unit that receives its power through a V-belt from a motor adjustably attached to the master head. Eight back-geared speeds are suitable for driving cutters ranging in size from a 1/4-inch end-mill to an 8-inch face mill. The master head can be elevated within the ram either by hand or power feed, and serves as a carrier for all attachments.

The rear ram is thoroughly counterbalanced, and reciprocates vertically from 0 to 4 3/4 inches at the rate of 80 strokes per minute, carrying the master head. The length of stroke is adjusted by dials. The master head has a vertical power feed, and travels either with the ram or independently of it. When locked by clamping nuts, the reciprocating rear ram serves as a fixed column.....60

Air-Lube Lubricators for Pneumatic Tools

An automatic lubricator for feeding a regulated amount of oil in the form of mist into air-operated tools through the air hose has been introduced to the trade by Filters, Inc., 1515 Gardena Ave., Glendale, Calif. This lubricator is designed to eliminate need for frequent oiling, to prevent freezing, and to prolong the life of air-driven equipment. It is exceptionally light in

To obtain additional information on equipment described on this page, see lower part of page 210.



EX-CELL-O CYLINDER BORING MACHINE

To left: Ex-Cell-O angular type machine equipped with six spindles to finish bore valve seats and valve guide holes in cylinder head of aircraft engine on a production basis. Each spindle is individually adjustable for depth of cut, as are the tools in the boring bars (boring bars, not shown in picture, are piloted in the fixture).

SPECIAL MACHINES

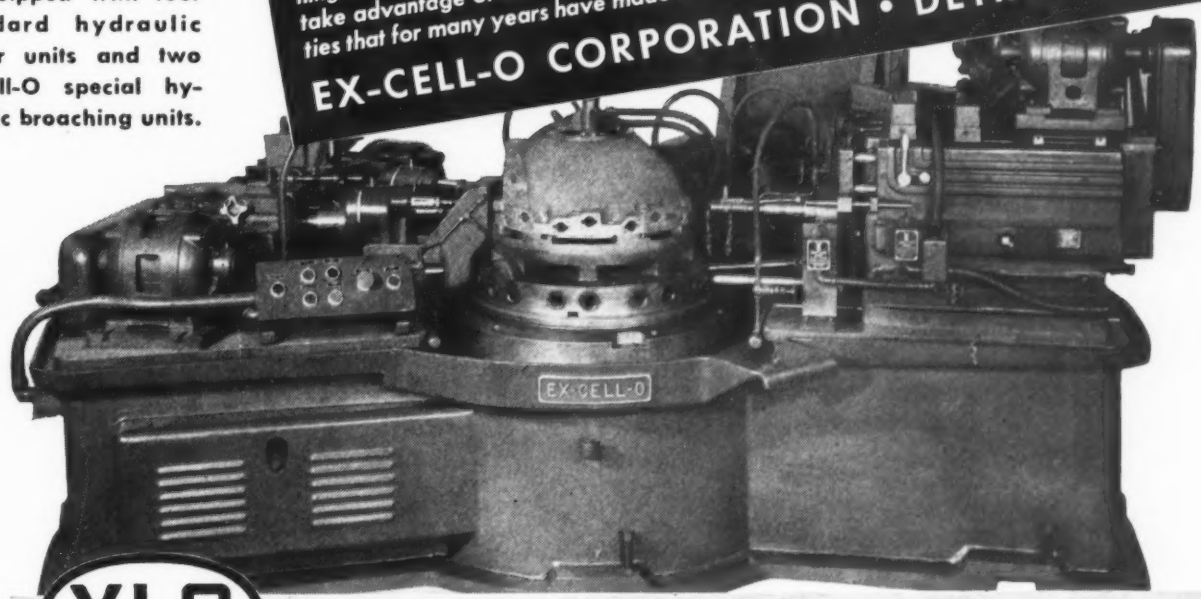
...for today's production...and tomorrow's

For years Ex-Cell-O has been familiarly known as "the headquarters" for special single-purpose machines for turning out accurate parts at a high rate of speed . . . machines that frequently perform numerous operations in one setting of the work and often bring not only a substantial increase in the number of parts produced hourly but also improved quality and reduced unit cost. . . . This is why so many manufacturers have turned to Ex-Cell-O for equipment to meet their war production schedules; why Ex-Cell-O designed machines will figure in the post-war plans of an increasing number of American industries. . . . If you are planning for tomorrow, when the new standards will necessitate costs that are competitive, take advantage of the wide engineering experience and extensive manufacturing facilities that for many years have made Ex-Cell-O a leader in the precision machine tool field.

EX-CELL-O CORPORATION • DETROIT, MICH.

EX-CELL-O SIX-WAY MACHINE

Below: Ex-Cell-O six-way machine for drilling, broaching and reaming valve guide holes in a magnesium crankcase. This machine is equipped with four standard hydraulic power units and two Ex-Cell-O special hydraulic broaching units.



XLO

EX-CELL-O *for* PRECISION

Precision THREAD GRINDING, BORING AND LAPPING MACHINES • TOOL GRINDERS • HYDRAULIC POWER UNITS • GRINDING SPINDLES • BROACHES • CONTINENTAL CUTTING TOOLS • DRILL JIG BUSHINGS • DIESEL FUEL INJECTION EQUIPMENT PURE-PAK CONTAINER MACHINES • R. R. PINS AND BUSHINGS • PRECISION PARTS

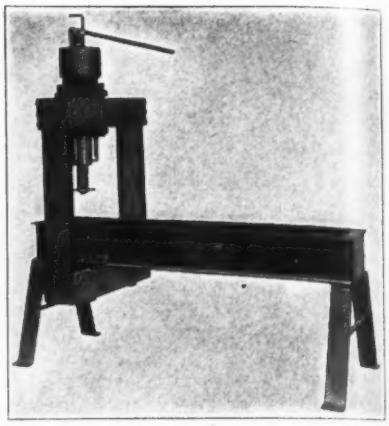
weight, and is recommended for use in the air hose from 1 to 6 feet from the tool. It can also be used in air pipes for larger air-driven stationary or semi-portable tools.

The positive feeding action feeds oil only when the tool is in operation. The oil reservoir holds enough oil for more than a week's operation under normal usage. A glance at the window in the oil reservoir shows when it needs refilling. 61

"Hy-Mac" Flame-Hardening Machines

A "Hy-Mac" floor model No. 502 flame-hardening machine has just been brought out by Hydraulic Machinery, Inc., 12825 Ford Road, Detroit, Mich. This machine has a base of welded steel construction, and is operated by a standard "Hy-Mac" power unit. It was designed especially for hardening sprockets, and is fully automatic in operation. At one side of the table is an indexing mechanism which holds the work and provides the required lifting and lowering movement. On the other side is a movable platform which facilitates loading and unloading, and on which two special water-cooled torch tips and two quenching nozzles are mounted. After the piece has been put in place in the machine, the entire heating and quenching operation is performed automatically.

A "Hy-Mac" bench model No. 501 flame-hardening machine, especially designed for hardening small parts of various shapes and sizes that can be handled by merely changing the multiple-duty holder and the tips on the burners, is another recent development of this company. At the end of the heating cycle of this machine, an automatic switch causes the solenoid to operate, allowing the part to drop into the quenching medium immediately under the fixture. 62



Improved 50-ton Press Built by Bee Line Co.

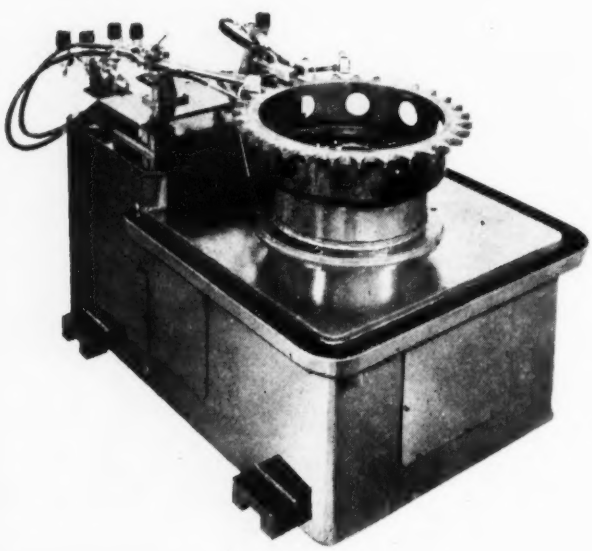
Improved Bee Line 50-Ton Press

A hydraulic press designed to meet the requirements of speed and dependability for all types of press work within the limits of its 50-ton capacity is being manufactured by the Bee Line Co., P. O. Box 569, Davenport, Iowa. This press is available with an 84- or a 96-inch bed.

The press itself is fitted to the bed with machine slides, so that it can be employed at any point along the length of the bed. A wide range of flexibility is also provided by the supporting construction, which permits the head to be moved crosswise. The press has a 16-inch clearance between the end of the ram and the top of the bed. A ram travel of 7 inches, combined with a quick-acting screw in the ram which also travels 7 inches, serves to give the press a total stroke of 14 inches. 63

Lyon Hydraulic Elevating Table

Improvements designed to extend the adaptability of the Lyon hydraulic elevating table have been incorporated in the latest model of this equipment brought out by the Lyon - Raymond Corporation, 1237 Madison St., Greene, N. Y. These new tables are adapted for handling dies; locating work in convenient positions for welding; transferring heavy parts from one level to another; supporting overhanging work; supporting work at convenient heights for the operator; and

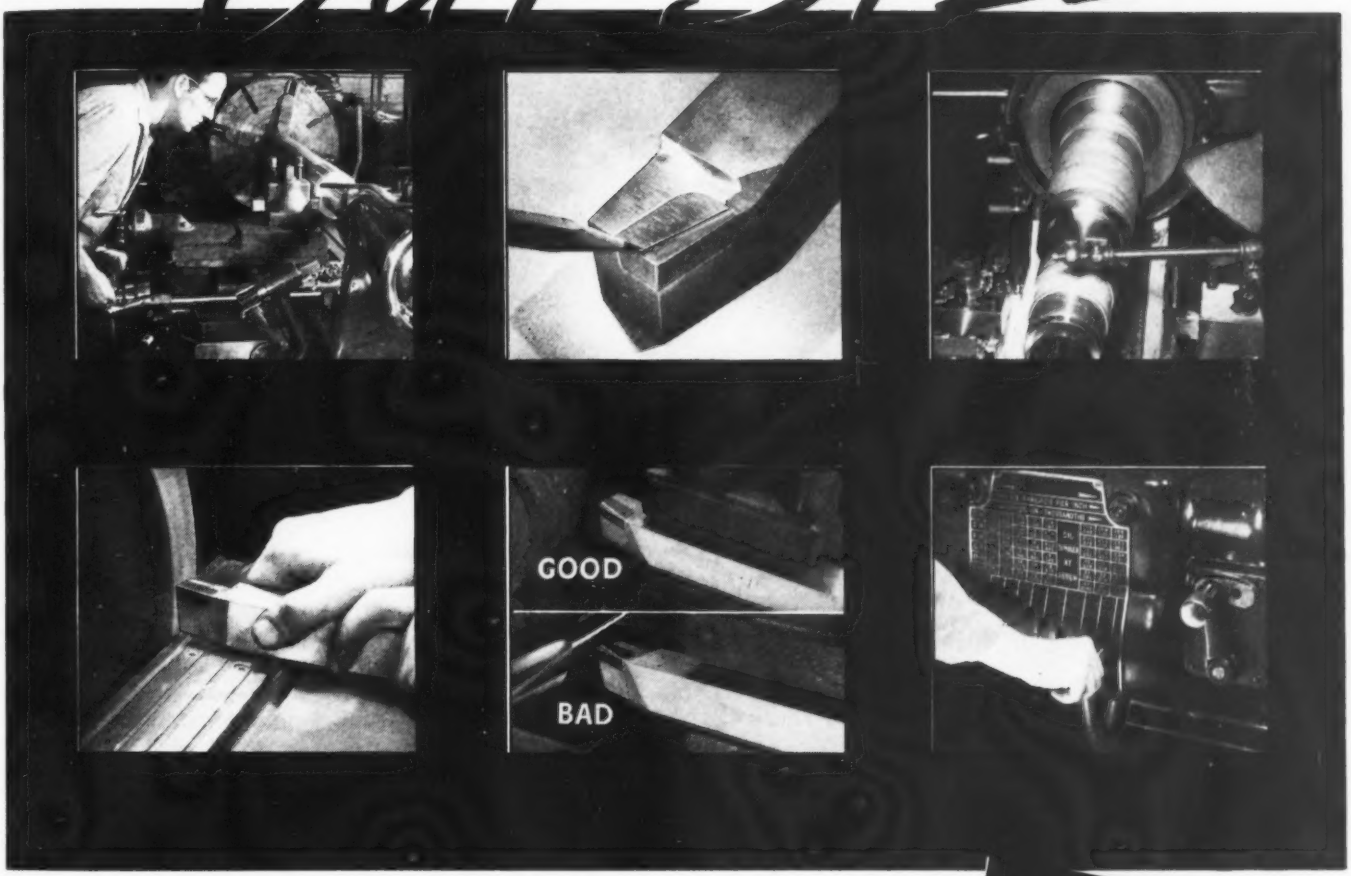


"Hy-Mac" Automatic Flame-hardening Machine

Lyon Hydraulic Elevating Table

To obtain additional information on equipment described on this page, see lower part of page 210.

6 STEPS TOWARD TOP PERFORMANCE, WITH CARBIDES, WHEN YOU *CUT STEEL*



● Important in getting top performance, when cutting steel with carbides, are the six steps shown above. When correctly applied, carbide tools produce results far surpassing the performance of ordinary tools. They operate at machine speeds as high as 4 to 5 times faster than ordinary tools, stay sharp up to 10 times longer, and increase output often as much as 300%.

Important, too, is the carbide you use. When you select from the complete line of carbides produced by Carboloy Company, you get the best type for your particular job—whether it be the popularly designated "titanium carbides", "tantalum carbides", "tungsten carbides"—or "tri-carbide" grades.

Send for catalog GT-142 listing specifications and prices of more than 300 standard Carboloy Cemented Carbide tools and blanks for machining all types of metals and non-metallics.

CARBOLOY COMPANY, INC., DETROIT 32, MICHIGAN

Birmingham · Chicago · Cleveland · Los Angeles · Newark · Philadelphia · Pittsburgh · Seattle

CANADIAN REPRESENTATIVE: Canadian General Electric Co., Ltd., Toronto, Ont.
FOREIGN REPRESENTATIVE: International General Electric Co., Schenectady, N. Y.

63% OF ALL **CARBOLOY** TRADEMARK CEMENTED CARBIDES PRODUCED TODAY FOR MACHINING PURPOSES IS USED FOR **CUTTING STEEL**

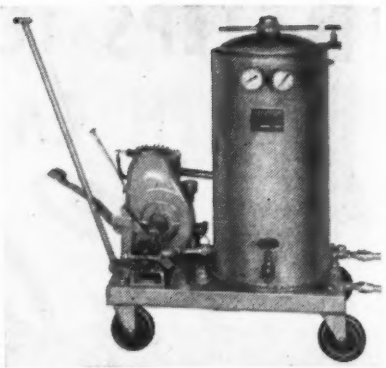
Are you using Carboloy Training Films? Six films available on Design, Application, Use of Chip Breakers and Maintenance. Send for Booklet GT-151.

CARBOLOY TRADEMARK

TITANIUM — TANTALUM
TUNGSTEN — CARBIDES

other operations for which foot-actuated elevating tables are advantageous.

The standard model of this new unit is made in the portable type, with two stationary and two swivel casters and with a single-speed hydraulic foot-pump. The table swivels, but can be locked in one position. It can be used for loads up to 2000 pounds. The table top is 30 inches square, has a lowered height of 29 inches, and an elevated height of 43 inches. Optional features include a floor lock designed to keep the table from moving on its casters; spring balanced towing handle; locking device which allows table top to be indexed and locked at each 15-degree position throughout a complete circle; collapsible retaining bars for table sides; four swivel casters in place of two swivel and two stationary casters; substitution of feet for casters; and two-speed hydraulic foot-pump. 64



Hilco Oil-filtering Unit

Vertical Bench Milling Machine with Horizontal Attachment

An improved vertical bench milling machine with a quick-change attachment for horizontal milling has been announced to the trade by the Benchmaster Mfg. Co., 2952 W. Pico, Los Angeles, Calif. The arm supporting the spindle head is 2 1/2 inches in diameter and is clamped rigidly to the column. It can be readily adjusted to rotate the spindle 60 degrees either side of the center. The entire head is removable, and can be replaced by an enclosed horizontal milling attachment. Thus, a variety of jobs, such as precision diemaking, die-sinking, profiling, jig-boring, key-slotting, etc., can be handled that would otherwise require a large machine.

This machine is compactly designed to handle large work in a small space. The machine is 30 inches high, and has a precision-ground table 6 by 14 inches, with three 3/8-inch T-slots. Micrometer adjustments for the table movements are operated by splined hand-cranks which can be easily disengaged, while dials graduated to 0.001 inch facilitate resetting.

A new sub-base has been added to increase the working height, for convenience of operation and greater rigidity. Proper tension on the V-belt is assured by a floating type of motor mount. Rapid changes of the four spindle speeds—450, 850, 1400, and 2100 R.P.M.—are accomplished without the use of tools. The spindle has a No. 2 Morse taper and is driven by a 1/3-H.P. motor. 65

Hilco Portable Oil Filters

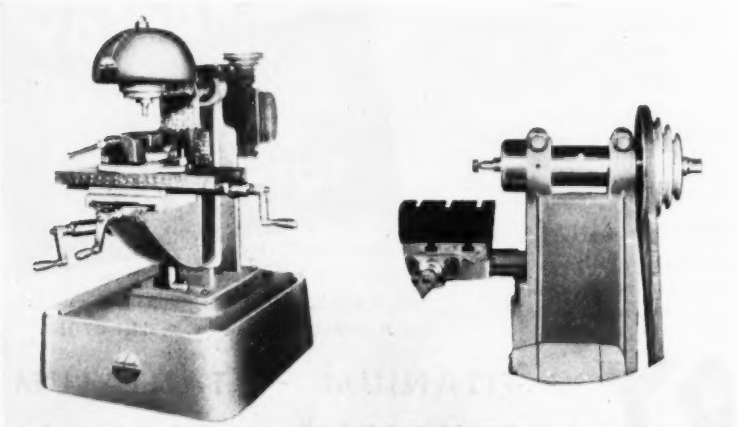
A self-contained oil-filtering unit that can be conveniently operated in remote sections or at points where electric power is not readily available is being manufactured by the Hilliard Corporation, 115 W. Fourth St., Elmira, N. Y. This unit consists of a standard Hilco "Hy-flow" oil filter and a small gasoline engine arranged to drive a rotary pump for forcing the oil through the filter. The exhaust gas is passed through a jacket around the filter for heating the filter.

These portable filters are suitable for filtering many types of oils, such as those used for lubrication and general use in Diesel engines, gasoline engines, steam turbines, steam engines, locomotives, vacuum pumps, hydraulic presses, air compressors, and airplane engines. They are also adapted for filtering machine tool cutting oils, insulating oils used in transformers and circuit-breakers, and fuel oil.

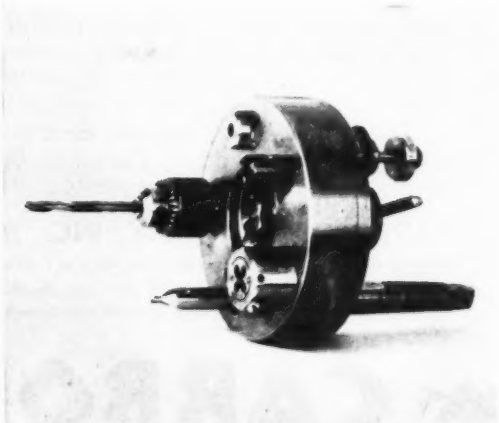
The unit is simply wheeled up to the equipment containing the oil, which is piped to the filter inlet, purified, and returned to the equipment; or this work can be accomplished by installing two tanks, one for the oil to be cleaned and one for the filtered oil. These filtering units are available in capacities ranging from one gallon per minute up to several hundred barrels of oil per hour, depending on the type of fluid filtered. 66

Koehler Tailstock Turret

A compact tailstock turret attachment for a lathe, which has five 5/8-inch holes in the indexing head to accommodate standard floating



Benchmaster Vertical Milling Machine and Horizontal Attachment



Koehler Tailstock Turret

To obtain additional information on equipment described on this page, see lower part of page 210.

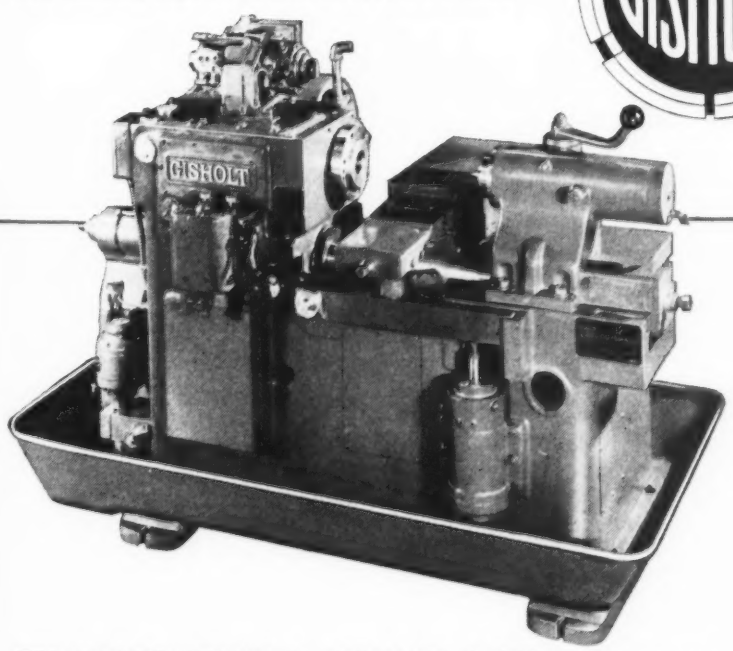
They said, "NO EXPERIENCE NEEDED!"

It's hard to imagine a machine easier to run than the Gisholt Hydraulic Automatic Lathe. Here, one small lever controls a whole cycle of machining operations. With but little more to do than load the chuck and remove finished work, one operator often tends several machines. Yet, here is sustained high-speed production and accuracy no skilled machinist could equal on a non-automatic lathe.

GISHOLT MACHINE COMPANY
1209 East Washington Avenue • Madison, Wisconsin

Look Ahead . . . Keep Ahead . . .
With Gisholt Improvements in Metal Turning

GISHOLT



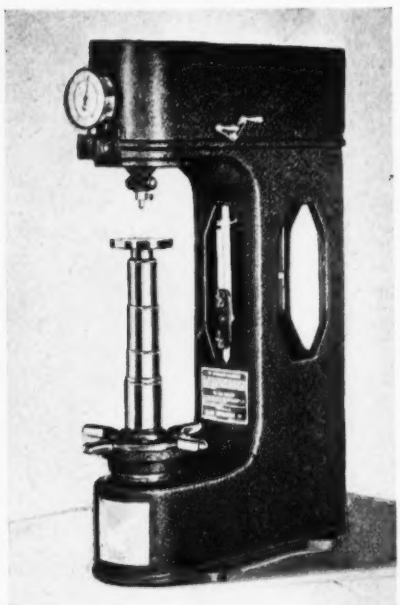
THE GISHOLT HYDRAULIC AUTOMATIC LATHE handles a wide variety of chucking and between-centers work. Its extremely rigid construction permits multiple cutting with accuracy at high cutting speeds. Ask for literature.

TURRET LATHES • AUTOMATIC LATHES • BALANCING MACHINES

tap- and die-holders or box-tools for drilling, tapping, or threading operations, has been added to the line of the Master Machine Co., 433 Main St., Stamford, Conn. This attachment is designed to provide sufficient clearance to avoid interference with the action of the turret head or other toolpost turrets of this company's manufacture now in use. The tailstock turret is equipped with a No. 2 Morse taper unless otherwise specified. 67

Clark Hardness Tester

Clark Instrument, Inc., 10300 Ford Road, Dearborn, Mich., has brought out an improved hardness tester for "Rockwell testing" in three models — US8, US12, and US16. This instrument is said to embody a number of new features that contribute to accuracy of measurement and speed of operation. It is supplied complete with diamond-cone penetrator and steel-ball penetrators for testing on the C scale, B scale, and most of the other standard Rockwell scales.



Hardness Tester Brought out by Clark Instrument, Inc.

Three anvils are included — a standard 3 1/2-inch anvil for large flat bearing surface work; a spot anvil for most standard-sized pieces and for use with test blocks; and a V-anvil for testing round and cylindrical parts. This equipment is in addition to the two smaller V-anvils of the adjustable steadyrest. 68

Improved Chip-breaker Grinder Built by Carboloy Company, Inc.

Chip-Breaker Grinder for Carboloy Tools

A new chip-breaker groove grinder for Carboloy tools having greater flexibility and higher production capacity than previous models has been brought out by the Carboloy Company, Inc., 11147 E. Eight Mile Road, Detroit, 32, Mich., to replace a former model. The new machine is designed for grinding chip-breaker grooves in single-point tools and roller turner tools. It can also be adapted for grinding flat form tools and round or square boring bits.

The length of the table, has been materially increased, and the construction has been strengthened. The long table, with a travel of 10 3/4 inches, makes possible the grinding of chip-breakers in both right- and left-hand tools without moving the universal fixture on the table.

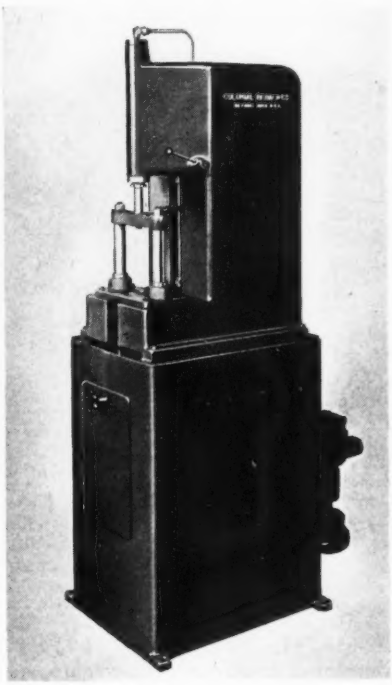
The head is vertically adjustable from either side of the machine, and will take 6-inch wheels. A 1/4-H.P., 110-volt, 60-cycle motor having a speed of 3450 R.P.M. is used. A universal fixture and vise for holding tools up to 1 1/4 inches wide is provided. A vise for holding tools up to 2 inches wide is also available. The fixture is so designed that it can be tilted to an angle of 90 degrees either side of the horizontal, and the center of the fixture can be cross-fed 1 inch past the center of the wheel. Standard equipment includes a wheel guard, lubricant tank, wrenches, light bracket, and reflector. 69

Colonial Improved "Junior" Hydraulic Presses

In addition to the bench models of the improved 1-ton capacity "Junior" hydraulic presses made by the Colonial Broach Co., 21601 Hoover Road, Detroit, 12, Mich., base type machines are now available. The base-equipped machines can be used for pull-down broaching operations, a suitable puller mechanism and coolant tank being located in the base. A coolant pump, driven by an integral motor, is provided at the rear of the base.

These presses can also be employed for push type broaching that requires the use of a coolant. Both the base and bench type models are available without the coolant reservoir and pump when required for assembling operations.

The "Junior" presses differ from the larger Colonial hydraulic presses mainly in capacity and size. The downward ram speed of 30 feet per minute is well adapted for broach-

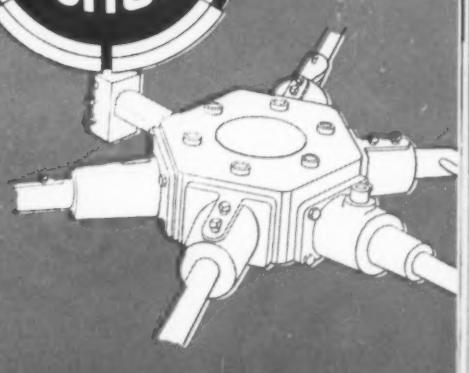


Base Type Hydraulic Press Made by Colonial Broach Co.

To obtain additional information on equipment described on this page, see lower part of page 210.

THAT'S NO WAY TO BEAT THE AXIS, SON!

GISHOLT



NEVER CLEAN A MACHINE WITH AN AIR HOSE! Strong blasts of air can blow fine chips and dirt into small clearance openings and bearings where they may lodge and cause serious failures.

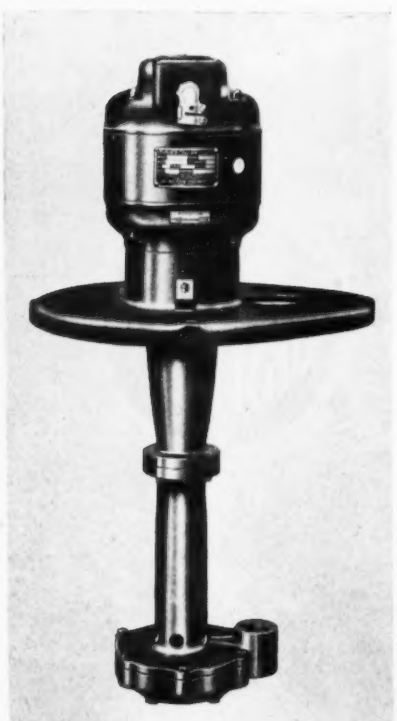
★ *Reprints of this page on enameled paper are available for bulletin board use in your turret lathe department. Write the Gisholt Machine Company, 1209 East Washington Avenue, Madison, Wisconsin. Ask for the series of "War-Time Care and Operation Posters."*

ing, as well as assembly work. A high-speed return of 60 feet per minute is provided for the up stroke. The stroke is adjustable up to a maximum of 12 inches. 70

Ruthman Gusher Coolant Pump

A vertical gusher coolant pump designed for deep immersion has been developed by the Ruthman Machinery Co., 1810 Reading Road, Cincinnati, Ohio. This pump—the Model TL—is capable of handling soluble coolants containing grit and abrasives without injury to the mechanism. The unit is provided with an integral mounting flange which is usually bolted to the reservoir cover or bedplate. This forms a simplified installation where a comparatively deep reservoir is located below the floor.

No packing glands or friction seals are used, and there are no metal-to-metal contacts below the mounting flange. The shaft, which rotates on two large ball bearings, is of one-piece construction and is ground accurately to insure balance. This pump is available in two lengths, measured from the mounting flange to the bottom of the pump. One length measures 23 5/8 and the other 19 5/8 inches. The pump is equipped with a 1/2-H.P. totally enclosed motor for continuous duty, and with a 3/4-H.P. motor for extra heavy duty.....71



Coolant Pump Developed by Ruthman Machinery Co.

Metal-Washing Machine

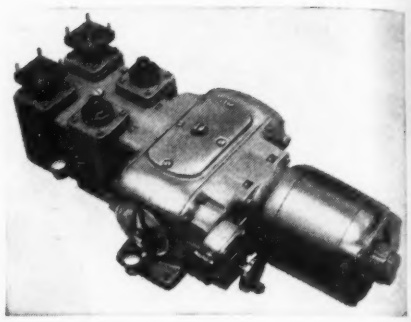
A metal-washing machine designed to meet the need for high-speed washing of flat, fragile work or round parts with intricate pockets and crevices, known by the trade name "Tabl-Spray," has been developed by the American Foundry Equipment Co., 555 S. Byrkit St., Mishawaka, Ind. Parts measuring 25 inches in diameter and up to 12 inches high can be handled on the regular size machine. Machines with 30- and 42-inch diameter tables for larger work are also available.

Typical cleaning operations for which this machine is suitable include the removal of lapping compound, the removal of oil and chips from magnesium and aluminum aircraft parts, and the cleaning of crankcases, supercharger rear housings and adapters, gears, rocker arms, etc. 72

Variable-Speed Drive for Testing Instruments

A compact, self-contained, variable-speed drive unit for testing instruments, such as aircraft tachometers, has been developed by the Link-Belt Co., Philadelphia, 40, Pa. This motorized, fully enclosed, splash-lubricated unit, of all-metal construction, has a 1/2-H.P. electric driving motor integrally mounted at one end. It utilizes the basic Link-Belt V.R.D. speed variator, has a speed ratio of 10 to 1, and is furnished with four vertical driving shafts, arranged for convenient coupling to the tachometers, or with a special swivel head to permit testing the instruments in either the horizontal or the vertical position. The four drives can be alike or in any desired combination. The accompanying illustration shows a test unit with two types of drives.

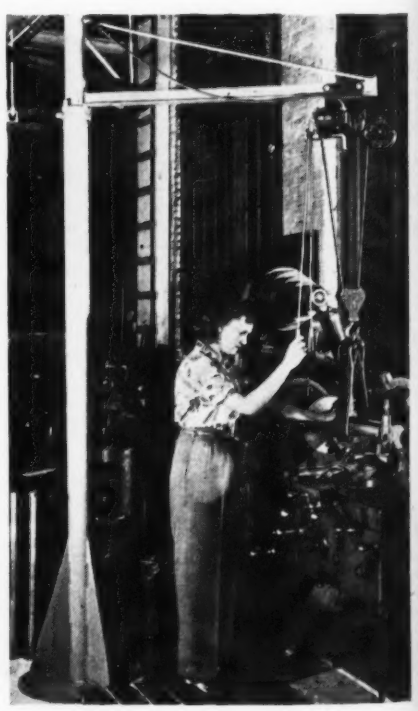
Output shaft speeds of 200 to 2000, 250 to 2500, and 300 to 3000 R.P.M. are available. The direction of rotation of each shaft can be selected to suit requirements. Stepless speed control is obtained by simply turning a handwheel. The unit is equipped with a dial and pointer for indicating the speed-ratio setting. For cases requiring exceptionally accurate testing, a fifth drive can be supplied on the gear-box. This may be a shaft for connection to a Stroboscope or Strobotron, or a master tachometer can be connected to either of the two types of drives. 73



Link-Belt Variable-speed Drive for Testing Instruments

Light-Weight Hoist

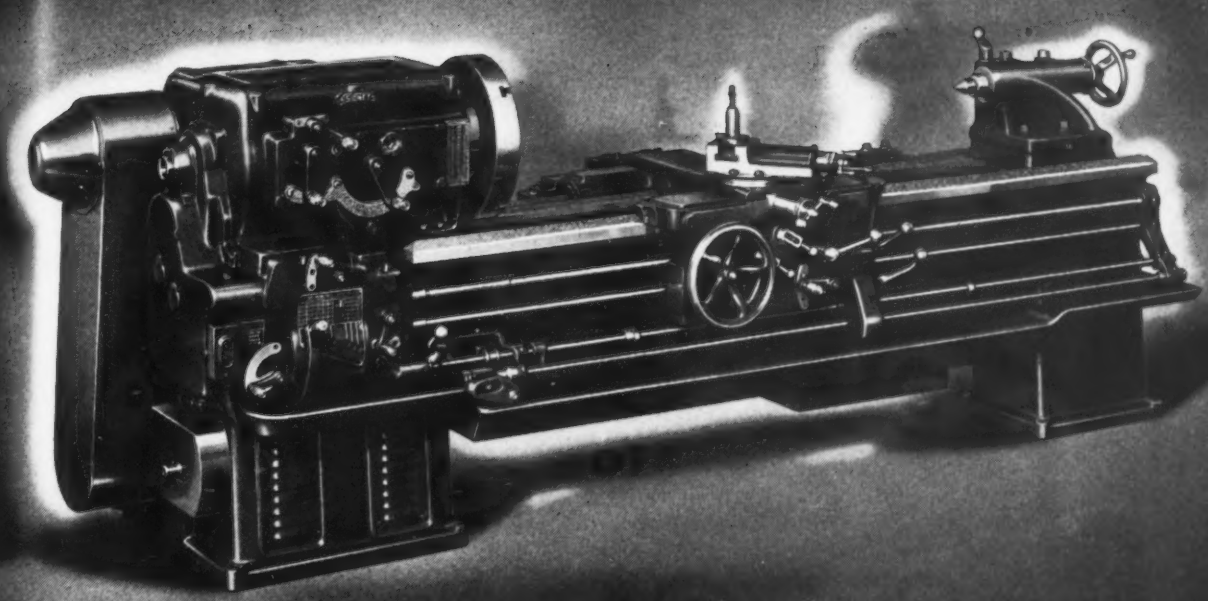
A light-weight cable hoist, known as the "Cablemaster," has just been brought out by the Industrial Equipment Division of the Master Electric Co., 126 Davis Ave., Dayton, 1, Ohio. This hoist is designed to enable women to handle scores of new jobs, and to permit both men and women who are now handling work by hand or with a gen-



"Cablemaster" Light-weight Hoist

To obtain additional information on equipment described on this page, see lower part of page 210.

Fire-Power on the Home Front



● Fire-Power in terms of Sidney Lathes is measured in smooth flow of power—stamina to take high speeds and heavy feeds—rigidity to maintain continued accuracy over 24 hour periods, month after month.

Such features as continuous tooth herring-bone geared head—center support for spindle and intermediate shaft in headstock—bed design that includes four walls and cross girts on twelve inch centers—spindle speed changes through internal and external gear tooth clutches are a few of the basic points of design and construction that permit Sidney Lathes to produce better work—more of it—over long periods.

Also the spindle center on the 18-20 inch lathe is only 42 inches from the floor—more convenient and less tiresome for the operator.

Full descriptive bulletin available—write.

SIDNEY
THE SIDNEY MACHINE TOOL CO., SIDNEY, OHIO, U.S.A.
Lathes

The SIDNEY MACHINE TOOL Company

Builders of Precision Machinery

SIDNEY — ESTABLISHED 1904 — OHIO

eral-purpose hoist to speed up production. The 250-pound capacity model shown in the illustration weighs only 65 pounds. It is equipped with hook or trolley mounting, and can be quickly attached to existing monorail mounting or to a special 4-foot jib crane, as shown.

The Cablemaster can be installed at each machine tool or bench to eliminate lost time in waiting for the shop overhead hoist. In addition to lifting parts into and away from machine tools, it can be used for inspection work. Three sizes, with capacities of 250, 500, and 1000 pounds are available, each being especially designed for its rating. 74

Onsrud Grinder for Sharpening Spiral Router Bits

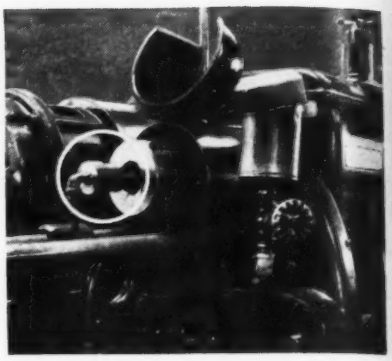
The Onsrud Machine Works, Inc., 3940 Palmer St., Chicago, Ill., has just brought out a machine for resharpening spiral router bits, designated the GF-41. It is claimed that this grinder will restore router bits to the condition in which they left the factory. The grinding wheel is driven by a three-stage air-turbine motor developing 3/8 H.P. at 30,000 R.P.M. The entire motor assembly can be swiveled to any desired grinding angle. Vertical, as well as in and out, adjustment of the motor unit is controlled by screws.

The bit to be sharpened is held in the chuck and moved toward and away from the grinding wheel by means of a hand-lever. The bit feed is controlled by a cam that insures the proper lead. A leather bellows, operated automatically as the bit is fed forward, removes the dust from the surface being ground.

The grinder is supplied with a 3/8-inch air-hose and coupling; a dial indicator for checking bit diameters; a positioner to insure proper chucking of the bit; an 80-grit polishing wheel; and a 120-grit grinding wheel. Adapters for taper-shank and 1/2-inch straight-shank bits, as well as a diamond-point wheel-truing device mounted in an adjustable holder, are included in the equipment. 75

Johnson Rotating Joint for Cutting-Oil Pipe Line

A special rotary pressure type joint is being manufactured by the Johnson Corporation, Three Rivers, Mich., to provide means for satisfactorily admitting oil under pressure inside the spindle of a turret lathe. With this oil-pipe connection, oil can be passed through the spindle to the tools at the working end.

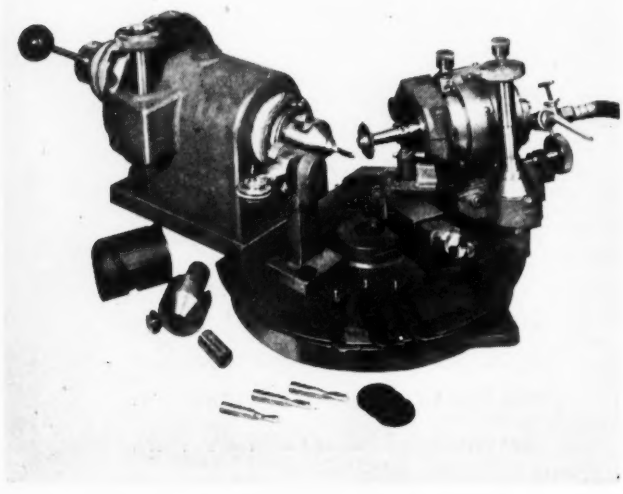


Machine Equipped with Johnson Rotating Oil-line Joint

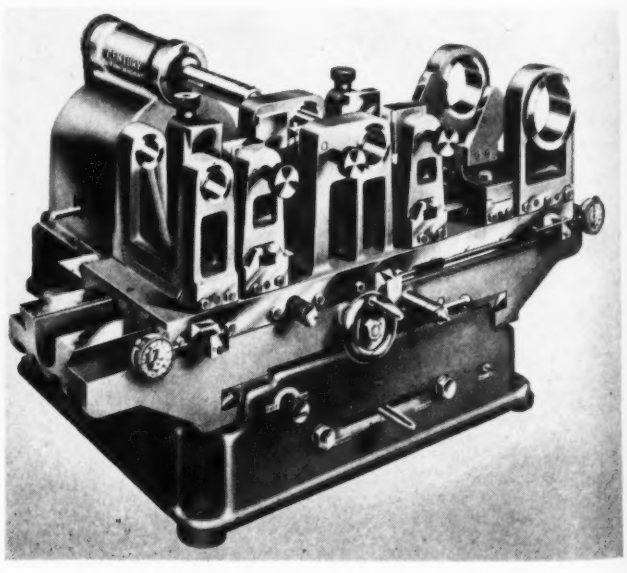
The joint is of the stuffing-box type without packing. Two self-lubricating carbon graphite rings of special composition eliminate any need for packing. Pressure within the joint itself provides the sealing force. This joint has previously been employed in the paper-making and textile industries for admitting steam or liquids under pressure to rotating rolls. 76

Century Connecting-Rod Boring Machine

A connecting-rod boring machine has been introduced to the trade by the Century Engineering Co., 816 W. 5th St., Los Angeles, Calif. This machine, while simple to operate and light enough for easy transportation, maintains the close tolerances required. It can be operated by any aircraft engine mechanic, and will hold tolerances within the limits established by the engine manufacturer.

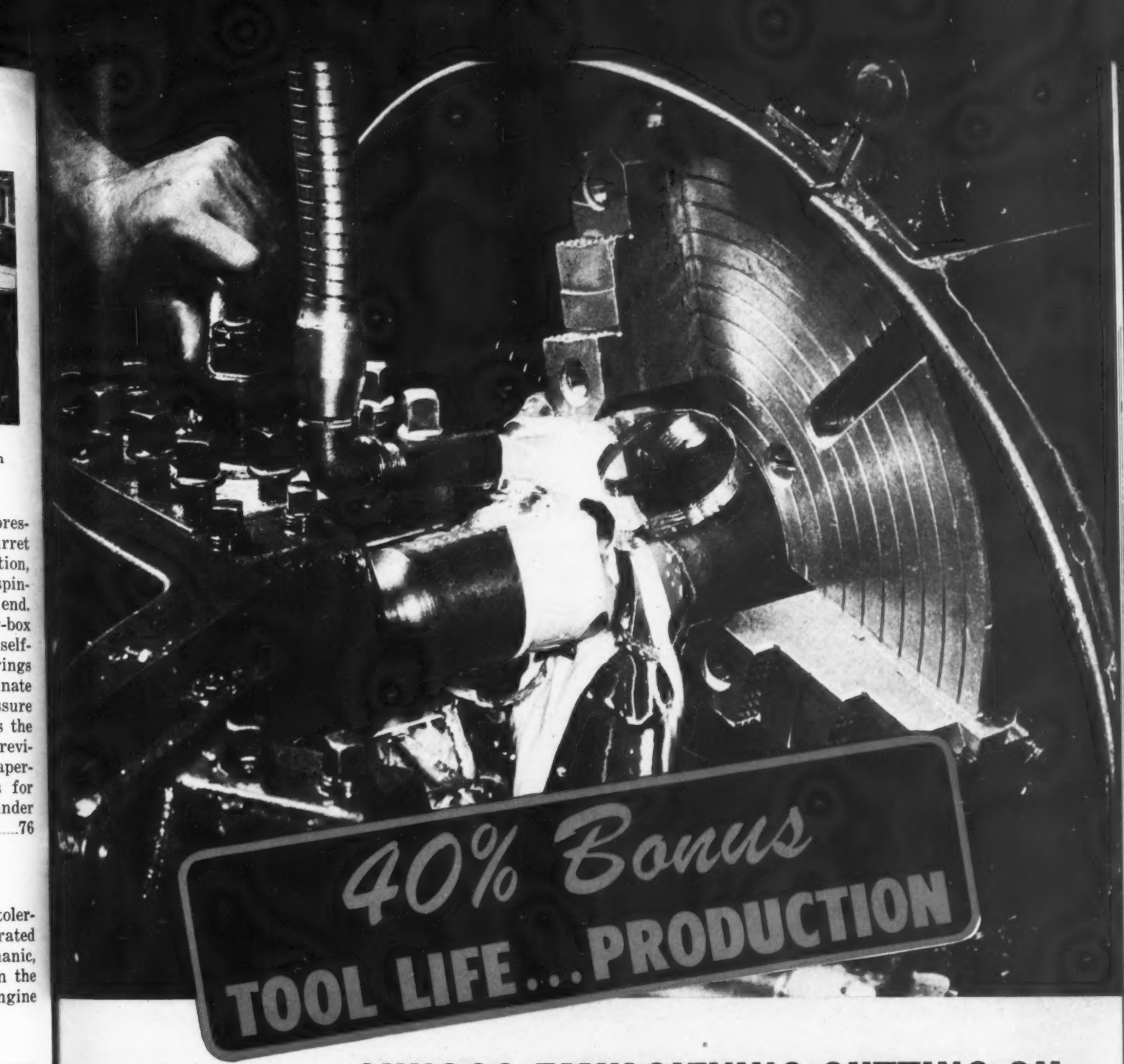


Grinder for Sharpening Spiral Router Bits, Made by Onsrud Machine Works, Inc.



Connecting-rod Boring Machine Placed on Market by Century Engineering Co.

To obtain additional information on equipment described on this page, see lower part of page 210.



SUNOCO EMULSIFYING CUTTING OIL

prolongs tool life... improves finish... increases production

The longer cutting tools last on the production lines ... the more vitally needed war material can be produced for the fighting line.

The value of the right cutting oil in prolonging tool life was amply proved by a large manufacturer of war material. When using a competitive cutting oil production was seriously slowed down because of short tool life . . . poor finish . . . and bad operating conditions. Then he switched to Sunoco Emulsifying Cutting Oil on his Warner & Swasey turret lathes. The high heat absorbing lubricating qualities of Sunoco stopped the trouble. Results . . . tool life and production stepped up 40% . . . finish on parts greatly improved.

From metal working plants large and small on America's production front reports such as these are constantly being received. Facts that prove why the majority of metal working plants flood their tools and work with Sunoco to get more pieces between tool grinds, reduce rejects, and make every man-hour and machine-hour result in peak production. Call in a Sun Doctor of Industry, let him prove the production value of switching to Sunoco in your own plant. Write

SUN OIL COMPANY, *Philadelphia*

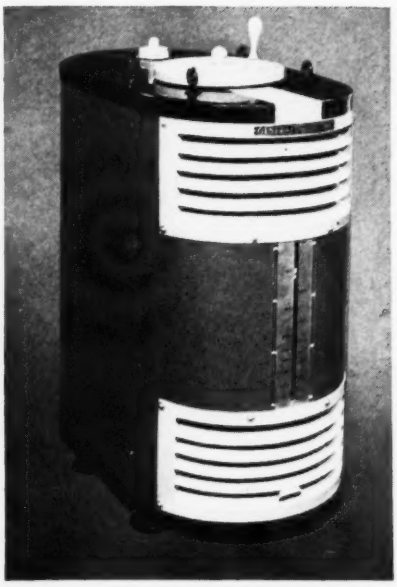
Sun Oil Company, Limited, Toronto, Canada

SUNOCO

SUN INDUSTRIAL PRODUCTS *HELPING INDUSTRY HELP AMERICA*

Only one 110-volt connection and one air-hose connection are required to place the machine in operation. The part to be bored is fed toward the boring-bar with a hydro-pneumatic feed. Space bars for the specific rod to be bored are used to insure accurate center-to-center dimensions. The rod is placed in the machine on two mandrels and held until the self-centering and self-equalizing clamps are tightened. The mandrels are then removed and the first hole bored.

Without changing the location of the rod, the entire fixture is moved to the second position by a handwheel which operates the cross-slide. After checking the work with a dial indicator, the second hole is bored. Since the rod is not released until both ends are bored, the holes are accurately aligned. 77



Outdoor Type Welder Made by General Electric Co.

Adjustable Corner-Notching Dies for Sheet Metal

The simplicity and ease with which the adjustable notching dies made by S. B. Whistler & Sons, Inc., 752 Military Road, Buffalo, N. Y., can be set up for operation on sheet-metal blanks is apparent from the accompanying illustration. With these standard notching units, the depth or angular position of the notches can be varied to suit requirements by simply changing the positions of the die units. The units can also be used in combination with special shapes and standard sizes of square- or round-hole adjustable punches and dies. 78

General Electric Outdoor Welder

A new 500-ampere outdoor alternating-current welder with a welding current range of from 100 to 625 amperes at 40 volts has been brought out by the General Electric Co., Schenectady, N. Y., especially for use in shipyards and for other outdoor work where the equipment is exposed to the weather. An "idlematic" control automatically reduces the output voltage to less than 35 volts whenever the arc is not in operation, but provides full power for welding the instant the arc is struck. This control also includes a switch operated by a handle which is extended through the top of the case to facilitate starting or stopping the welder.

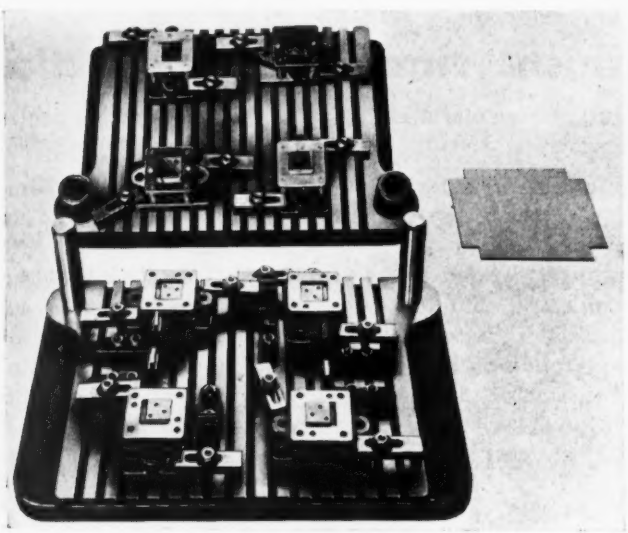
Protection against rain is provided by drip-proof construction of all openings in the top of the case and by a sealed window over the current indicator. Wide louvers serve to shed the water and to keep the air velocity low. All internal parts have a special finish for protection against corrosion from moist air. The welder has all the desirable features incorporated in the General Electric indoor welders of this type. 79

Hilco All-Angle Vise

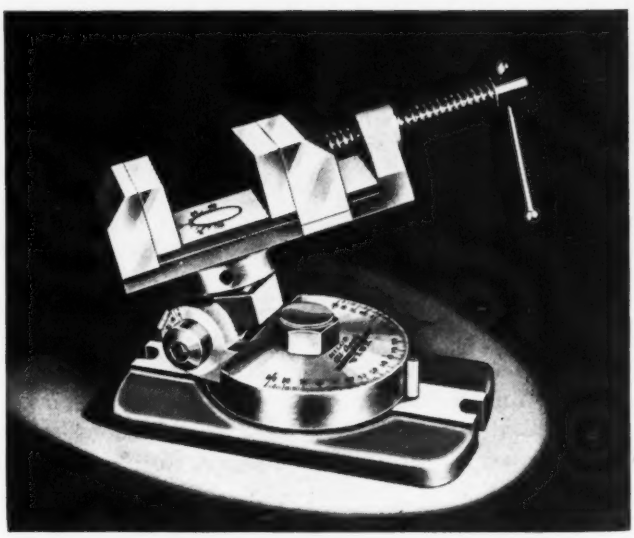
The Berco Mfg. Co., 429 W. Superior St., Chicago, Ill., is placing on the market a new Hilco All-Angle "Driv-Wheel Movement" vise designed by Melvin Douglas & Associates, Chicago, Ill. This vise has three accurate protractor dials for horizontal, vertical, and angular settings.

The features of the new vise include a patented drive-wheel motion which gives a lateral clearance of 2 3/4 inches; double-swivel construction which permits setting to any horizontal position; right-angle clearance which allows perpendicular positioning without base obstruction; positive horizontal setting for 180 - degree position; elimination of excess weight; and improved construction designed to insure easy handling by men or women workers.

This vise is suitable for magnetic



Whistler Adjustable Corner-notching Die



Hilco All-angle Vise Made by Berco Mfg. Co.

To obtain additional information on equipment described on this page, see lower part of page 210.

The new K type Navy blimp is able to fly at 80 miles per hour or to hover motionless over a lurking submarine. These airships have proved an efficient answer in protecting coastwise shipping against the undersea menace.

★★★ *Guardian Angel* OF THE CONVOY

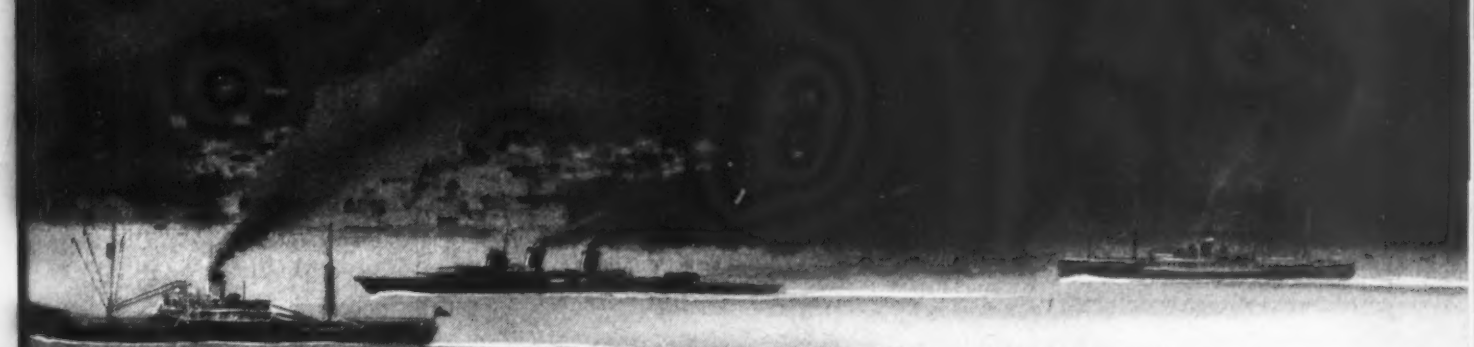
Swinging majestically over the convoy, the blimps are proving an effective answer to the submarine menace. Sinkings have been practically eliminated in convoys so guarded.

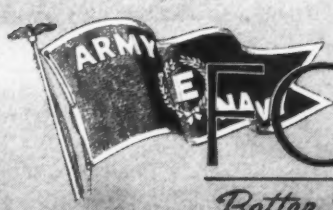
Able to scan the ocean for miles, able to see below the waves, able to hover over the slowest tanker, or to fly at many times the speed of the fastest wolf pack, these guardian angels of the fleet owe much of their effectiveness to the engines that power them.

And in these Pratt and Whitney engines, as in every part of the ship, weight is a vital factor. To produce gears of the necessary lightness—of the extreme precision that this lightness, coupled with tremendous horsepower, demands—meant a new conception in gear manufacture. Today, these gears are being produced at Foote Bros. in amazing quantities.

The new manufacturing techniques, new production know-hows that make these lightweight, high-precision gears possible, will mean better performance and greater operating efficiency when they are applied to peacetime machines.

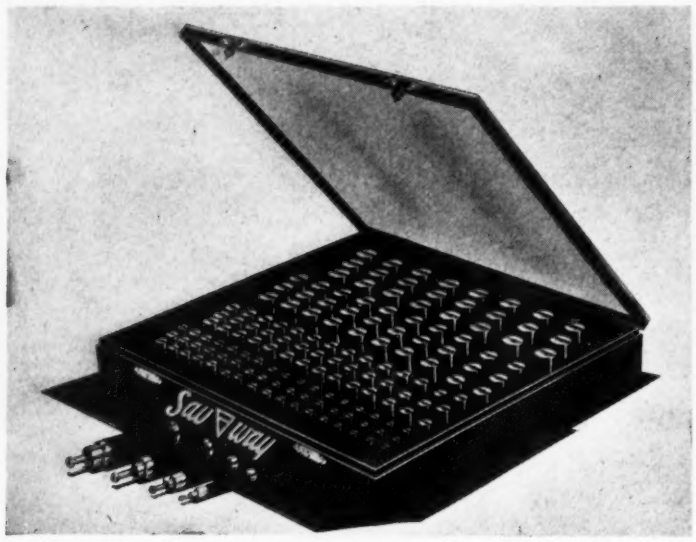
FOOTE BROS. GEAR AND MACHINE CORPORATION • 5225 S. Western Boulevard, Chicago, Illinois





FOOTE BROS.

Better Power Transmission Through Better Gears



Master Plug Gages Brought out by Sav-Way Industries

Grinding Point with Demountable Spindle

chucks, grinders, drill presses, milling machines, and other machine tools, as well as for bench use. It is especially adapted for use with the Hilco universal cutter-grinder. Three sizes, with jaw widths of 3 1/2, 4 1/2, and 6 inches are available. 80

"Cal-Cutter" Milling Cutters

The Machinery Mfg. Co., 1915 E. 51st St., Vernon, Los Angeles, Cal., manufacturer of the Vernon line of machine tools, is now making carbide-tipped milling cutters of many types and sizes under the trade name "Cal-Cutters." Standard styles include end-mills, staggered-tooth mills, shell end-mills, standard and heavy-duty face mills, hyper mills, half side mills, slitting saws, interlocking cutters, etc.

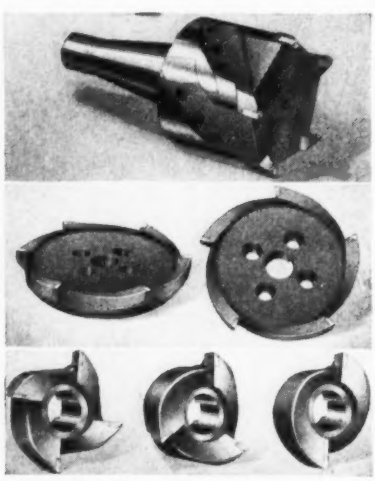
Two cutters in this new line of unusual design are bore face mills, and adjustable face and step mills. Each of these types of cutters has radius adjustment, the cutters being wedge-clamped in the bore face type and available with two, three, or five tips. The adjustable face and step mill cutter has four or six tips, and is made in two models, each type being adjusted by a micrometer screw.

"Cal-Cutters" are being made in designs adapted for milling cast iron, cold-rolled steel, heat-treated steel, aluminum, duralumin, etc. They are designed with a view to eliminating chatter and producing free cutting with minimum power consumption. 81

Sav-Way Master Set of Plug Gages

Sav-Way Industries, 4861 E. Eight Mile Road, Detroit, Mich., has brought out a new master set of standard plug gages for hole inspection. The set includes 147 plugs and four handles in a plastic case. The case has a transparent cover which permits a clear view of the contents.

The plugs increase in size from 1/4 to 1 inch in increments of 1/64 inch. Three plugs are furnished for each nominal size, one being 0.0005 inch over, one standard, and the other 0.0005 inch under size. All plugs are "deep-frozen" to relieve internal strain and accelerate aging. These plugs are held to gage-makers' "X" tolerance, and have a lapped finish. 82



"Cal-Cutter" Milling Cutters Made by Machinery Mfg. Co.

Abrasive Points with Demountable Spindles

The Abrasive Co., Tacony and Fraley Sts., Philadelphia, 37, Pa., has announced a new development in abrasive mounted wheels and mounted points to be known as Victory points. The outstanding feature of these new points is the demountable spindle, which permits the spindle to be removed and used with other points, thus saving steel.

Victory points consist of a threaded porcelain bushing inserted in and fused to the abrasive wheel mass at the high heats of kiln temperatures during the vitrification process. The threaded bushing is, therefore, a part of the abrasive wheel. The demountable spindle simply screws into the porcelain bushing and forms a tight fit, so that the spindle cannot break off, pull out, twist, or turn. It can, however, be easily unscrewed and replaced with a new point.

The points and wheels are made in standard grain and grade combinations. The demountable spindle size is limited to 1/4 inch diameter by 1 1/4 inches long. 83

Moisture-Resistant Tracing Cloth

A white pencil tracing cloth known as "Whitex" has been developed by the Frederick Post Co., P.O. Box 803, Chicago, Ill. One of the outstanding features of this new tracing cloth is that it is moisture-resistant on both sides. In many localities, these moisture-

To obtain additional information on equipment described on this page, see lower part of page 210.

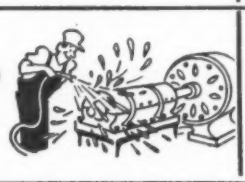
ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

ONE OF A SERIES OF SUGGESTIONS TO AID PRODUCTION

Have You a Tough Grease Problem?

HOW TO SOLVE Operating Problems with *Correct Lubrication*

JUST LOOK AT SOME OF THE OPERATING CONDITIONS SPECIAL GARGOYLE GREASES ARE LICKING. THE EXPERIENCE THAT DEVELOPED THESE GREASES IS AVAILABLE TO YOU...

HIGH TEMPERATURE	OVER 400° F.		Gargoyle Grease BRB4 Gargoyle Sovarex Grease
EXCESSIVE WATER	WATER-FLOODED BEARINGS		Gargoyle Grease AA Gargoyle Sovarex Grease
EXTREME SPEEDS	20,000 TO 50,000 R. P. M.		Gargoyle Grease BRB4 (for ball bearings)
HIGH PRESSURES	MEETS MOST SEVERE STEEL MILL USE		Gargoyle Grease Sovarex L
LOW TEMPERATURE	−40° F.		Gargoyle Mobilgrease Zero
WIDE TEMPERATURE RANGE	+250° F. TO −60° F.		[Name on Request]

GARGOYLE Lubricants

IF YOU are responsible for the operation of any machines or equipment that are grease-lubricated—*be sure you've heard the Gargoyle Grease story!*

There is available to you the same full line...the same high quality in Gargoyle *Greases* that you have learned to depend upon in Gargoyle *Oils.*

And they are sold on the same basis i.e. *their use will bring you benefits in power and maintenance economies...and in full time, capacity production!*

SOCONY-VACUUM OIL CO., INC.— Standard Oil of N. Y. Div. • White Star Div. • Lubrite Div. • Chicago Div. White Eagle Div. • Wadhams Div. • Magnolia Petroleum Co. • General Petroleum Corporation of California

HEADQUARTERS FOR GREASES TO MEET EVERY PROBLEM—

SOCONY-VACUUM

resistant surfaces are a safeguard against climatic conditions. The possibility of obtaining jet-black pencil lines and the marked transparency of this tracing cloth are also valuable features. 84

Whitcomb "Quickcenter" Machine for Centering Round Bars

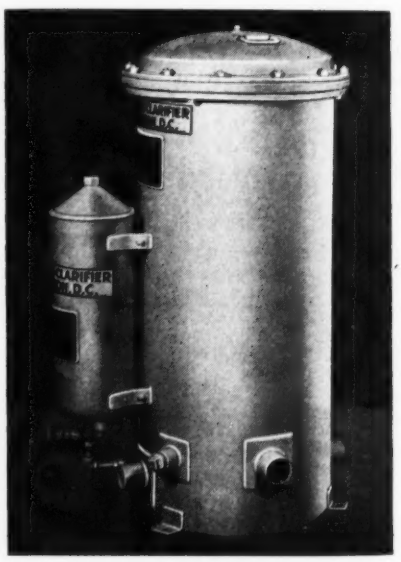
The Whitcomb Mfg. Co., 476 Eighth St., Troy, N. Y., has placed on the market a machine for centering round bars preliminary to machining on centers. This machine, designated the "Quickcenter," has been designed to enable inexperienced operators to center bars quickly and accurately. After placing the work on the V-block, the handwheel is turned, which causes the V-block to rise and a button to be lowered against the work, thus holding it securely. When thus clamped, the work is in line with the center drill in the spindle. The hand-lever is then used to advance the center drill to the work. Since the operator moves only the handwheel and the lever, it is possible to perform the centering operation in a fraction of the time required when this work is done in the lathe.

Whitcomb Centering Machine for Round Bars

The "Quickcenter" is equipped with a 1/4-H.P. motor, and has speeds of 700, 1300, and 2300 R.P.M., which are obtained by a three-step V-belt sheave. The machine will center round bars from 1/2 inch to 3 inches in diameter within 0.005 inch. 85

Briggs "Filter-Clarifier"

An oil filter, designed to combine the advantages of the "100 per cent flow" and the "by-pass or shunt" type filters, which is designated the Filter-Clarifier, has just been placed on the market by the Briggs Clarifier Co., 1339 Wisconsin Ave., Washington, 7, D. C.

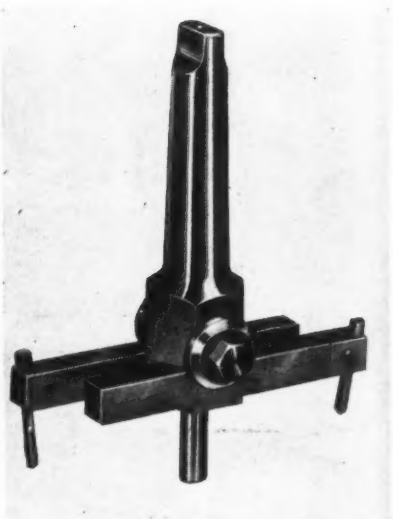


"Filter-Clarifier" Made by Briggs Clarifier Co.

The filter section is equipped with long-fiber cellulose cartridges, and designed to take the complete flow of the system, thus removing all solid contamination and continuously maintaining the oil free of oxidation products. The Filter-Clarifier is available in capacities ranging from 5 to 200 gallons per minute. 86

Clark Adjustable Fly Cutters

The Robert H. Clark Co., 3424 Sunset Blvd., Los Angeles, 26, Cal., has added to its line of adjustable cutting tools a new fly cutter for cutting holes in materials up to 1 inch thick, including boiler plate, stainless steel, cast iron, plastics,



Adjustable Two-blade Fly Cutter Made by Robert H. Clark Co.

etc. The tool can also be used for cutting disks from these materials. One of the difficult operations successfully performed by this fly cutter is cutting washers and gaskets from "live" rubber and other substances that are hard to work. The cutter has been designed to provide considerable clearance between the work and the body of the cutter to make possible deeper cuts with less strain on the tool. The blades are arranged to eliminate chatter and assure clean-cut holes.

The tool illustrated is obtainable with straight or tapered shank, and has an expansion range of 4 to 10 inches in diameter, including all decimal or fractional intermediate sizes. Similar tools having three cutting blades are available for cutting holes from 5/8 inch to 5 inches in diameter. These tools can be used for cutting holes in pipe and curved surfaces as well as flat work.

A new adjustable surface facing tool, made in four models to cover a range of capacities from 1 inch to 5 inches in diameter, has also been brought out by this company. The bits of all these tools can be easily reground or they can be replaced with new bits at comparatively small cost. 87

Tungsten-Carbide Tipped Tools

A complete line of tungsten-carbide tipped tools is being introduced on the market by the New England Carbide Tool Co., 60 Brookline St., Cambridge, Mass.

To obtain additional information on equipment described on this page, see lower part of page 210.

THIS IS THE WHEEL MR. JONES

● Maybe you were stumped by grinding jobs before, but they won't worry you any more.

300 shapes and sizes—every grade and grain—there is a Chicago Mounted Wheel custom built to take on *any* grinding problem. Each wheel is a whirling point of power that turns your job out smooth—and in a hurry.

PROMPT DELIVERY

Action is the keynote from the moment your order comes in. Our wartime set-up concentrates on mounted points and grinding wheels 3" in diameter and under. —Production is stepped up and keeps pace with demand. Another advantage to you is our central location.

NEW CATALOG—Shows Chicago Mounted Wheels in actual colors, also portable electric tools and time-saving accessories.

CHICAGO WHEEL & MFG. COMPANY

America's Headquarters for Mounted Wheels and Small Grinding Wheels.

1101 W. Monroe St., Dept. MR
Chicago, Illinois

☐ Send Mounted Wheel Catalog MR-8
☐ Free Wheel. Size.....
☐ Also interested in Grinding Wheels

Name.....

Address.....

This line includes four styles of tools, both right- and left-hand, as well as pointed and square tipped tools. These tools are regularly furnished in a "U" grade for cutting all materials except steel, such as aluminum, cast iron, brass, bronze, non-metallics, etc., and in an "S" grade for cutting steel. 88

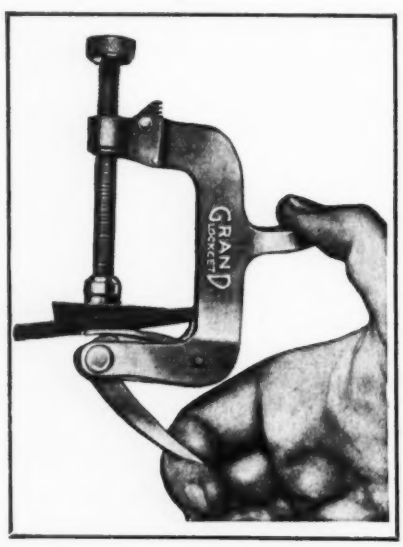
Quick-Acting Clamps

The Grand Specialties Co., 3126 W. Grand Ave., Chicago, Ill., has brought out three new lines of quick-acting clamps known as the "Quick Lockcet," the "Heavy-Duty Speed" clamp, and the "Alloy-Steel" standard C-clamps. The "Quick Lockcet" clamps are designed for light, fast work and have instantaneous trigger release. The seat of the clamp has a swinging locking lever which assures a firm grip on any flat, slanting, or rounded surface.

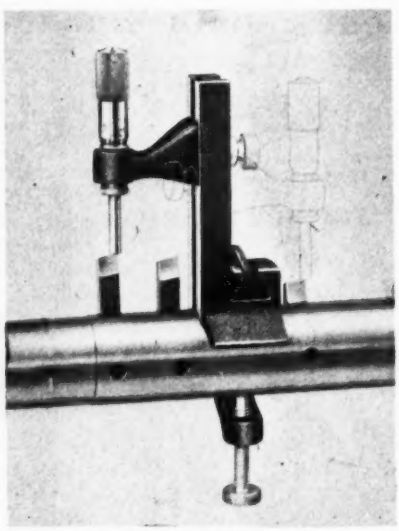
The released screw can be slid quickly to any desired position with a single motion for immediate resetting or it can be used to clamp other work of the same thickness without further adjustment. The clamp has a free-acting swivel with fiber face to prevent marring the work, and may also be obtained with complete fiber jaws for aluminum and other softer metals. Both types are made in three sizes, and all have copper-plated screws and swivels to prevent damage from welding spatter.

The "Heavy-Duty Speed" clamp is a new development for large, heavy work, such as welding heavy plate, building dies, and welding bulky members. It is a two-handed, lever-operated clamp designed for production use on identical pieces. This type is also made in a giant size which has an opening of 10 1/2 inches.

The "Alloy-Steel" standard C-clamps are designed to combine greater strength with lighter weight. They are intended for general use where a heavy-duty clamp is not required, but where strength and light weight are desirable. 89



"Quick Lockcet" Clamp Made by Grand Specialties Co.



Bartelt Pedestal Type Micrometer

Micrometer for Setting Boring-Bar Tool

The Bartelt Engineering Co., 1412 Partridge Ave., Beloit, Wis., has recently placed on the market a Model B pedestal type micrometer designed primarily for the rapid and accurate setting of closely spaced boring tools. This micrometer can also be used to advantage for a variety of gaging operations. It consists of a pedestal having a base with a wide vee opening and flat surfaces at the ends of the extensions. The micrometer can be located on a boring-bar by means of the V-groove, and held in place by a removable clamp which engages a slot in the top of the base.

The flat surface makes it possible to place the gage on a surface plate, a machine bed, or any plain surface from which measurements are to be made. The flat portion of the base also permits the pedestal micrometer to be used as a height gage or depth gage. 90

Grayson-Kennametal Milling Cutter

Milling Cutters Tipped with Kennametal

A new line of milling cutters designed for maximum speed and production has been made available by Kennametal, Inc., 147 Lloyd Ave., Latrobe, Pa. The new cutters, known as "Grayson-Kennametal," have strong bodies of Meehanite tipped with Kennametal. Thus the shock resistance of the Meehanite body is combined with the hardness and the strength of Kennametal to produce a rugged tool for rapid and accurate face-, side-, end-, slot-, and straddle-milling.

These milling cutters are available with double negative-rake angles in grade KM for milling steel, and with positive-rake angles in grade K2S for rough-milling cast iron, or in grade K4H for milling aluminum-silicon alloys, magnesium-aluminum alloys, brass, bronze, and most other non-ferrous metals. 91

Diamond Dressing Tool for Thread-Grinding Wheels

A new type diamond dressing tool for thread-grinding wheels has been developed recently and placed on the market by the Wheel Trueing Tool Co., 3200 W. Davison, Detroit, Mich. This new tool utilizes the characteristics of the natural uncut diamond, and can be employed for straight dressing, as well as angle, radial, and multiple form dressing. It can be used for dressing wheels for grinding Whitworth, buttress, Acme or any other thread. The clean cuts taken by these tools permit handling more work between dressings. 92

To obtain additional information on equipment described on this page, see lower part of page 210.

SAVE HOURS OF TRAINING for your Screw Driving Army

PHILLIPS SCREWS ARE FOOL-PROOF!

Light-fingered and feminine . . . heavy-handed and he-man . . . raw recruit or veteran. All can be put on a high-production level on your assembly line by giving them Phillips Recessed Head Screws.

The scientifically designed Phillips Recess automatically centers the driving force and eliminates all driving troubles . . . fumbling, wobbly starts . . . slant-driven screws . . . burred and broken screw heads . . . and dangerous screw driver skids.

Screw and driver "become one unit", making such efficient use of turning power that driving is much easier and faster, regardless of driving method. And, power driving is made practical in most cases.

They cost less to use! Compare the cost of driving Phillips and slotted head screws. You'll find that the price of screws is a minor item in your total fastening expense . . . that it actually costs less to have the advantages of the Phillips Recess!

KEY TO FASTENING SPEED AND SAFETY

The Phillips Recessed Head was scientifically engineered to afford:

Fast Starting – Driver point automatically centers in the recess . . . fits snugly. Screw and driver "become one unit." Fumbling, wobbly starts are eliminated.

Faster Driving – Spiral and power driving are made practical. Driver won't slip out of recess to injure workers or spoil material. (Average time saving is 50%.)

Easier Driving – Turning power is fully utilized by automatic centering of driver in screw head. Workers maintain speed without tiring.

Better Fastenings – Screws are set-up uniformly tight, without burring or breaking heads. A stronger, neater job results.

PHILLIPS *Recessed Head* SCREWS

WOOD SCREWS • MACHINE SCREWS • SELF-TAPPING SCREWS • STOVE BOLTS

21 SOURCES

American Screw Co., Providence, R. I.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
The H. M. Harper Co., Chicago, Ill.
International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
The Charles Parker Co., Meriden, Conn.
Parker-Kalon Corp., New York, N. Y.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Reading Screw Co., Norristown, Pa.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.
The Southington Hardware Mfg. Co., Southington, Conn.
Whitney Screw Corp., Nashua, N. H.

Carbide-Tipped Milling Cutter

A new type of carbide-tipped milling cutter with a cast-alloy body has been developed by the Super Tool Co., 21650 Hoover Road, Detroit, Mich. This cutter is made with a minimum number of flutes, and is simply constructed to reduce the cost to a point where it can be used generally on short runs and for ordinary shop tooling in accordance with the manufacturer's recommendations.

The higher speeds at which these carbide-tipped cutting tools can be operated permit increased table feeds, which are said to produce finishes comparable to those obtained by grinding. It is also claimed that greater accuracy is obtained by these higher speeds.

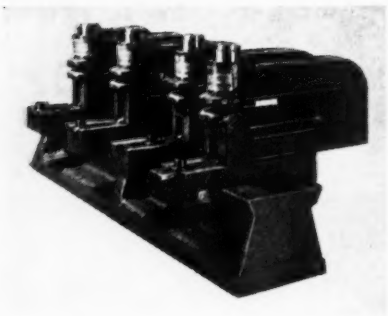
Cutters for cast iron, brass, bronze, copper, aluminum, magnesium and plastics are regularly

Carbide-tipped Milling Cutter Made by the Super Tool Co.

supplied in diameters from 3 to 8 inches and in a variety of widths, with four or six flutes. The various sizes for cutting steel are made with from six to sixteen flutes, according to the diameter. 93

Wales Hole-Punching Units with Adjustable Adapters

The Wales-Strippit Corporation, 345 Payne Ave., North Tonawanda, N. Y., has recently developed adjustable adapters for mounting Wales Type B hole-punching units on press-brake rails for staggered or straight-line hole-punching. The



Wales Hole-punching Units

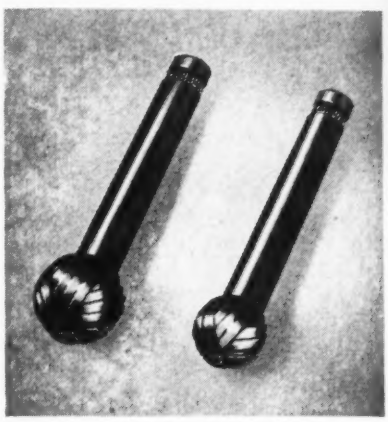
maximum front-to-back adjustment of these adapters is 3 inches.

The units are designed for interchangeable use on press-brake rails with the adapters, and on punch presses with T-slotted plates and templets. Set-ups on T-slotted plates and templets can be made quickly by simply bolting the units directly to the plates and templets in the exact positions determined by a master pattern. These self-contained units are not connected to the press ram in any way. Backstop and gage rods with a minimum center-to-center spacing of 1 3/8 inches in throat depth and up to 18 inches are available. 94

Cemented-Carbide Burring Tools

Carbur, Inc., Lincoln Park, 25, Mich., has brought out what are claimed to be the first cemented-carbide burring tools or rotary files. These tools are the result of five years' research and development work in the grinding and forming of cemented carbide. The tools, to be known as "Carburs," have cutting teeth that are ground from the solid on machines designed expressly for this purpose. Results of tests conducted in actual production indicate that Carburs will have at least fifty times the tool life of previous burring tools.

With these tools, sharpening requirements are reduced in proportion to their longer life. They can be run at much higher speeds than have been possible with previous tools. At the present time, these tools are supplied only in ball-end types and in 3/8- and 1/2-inch sizes. These dimensions refer to the diameter of the carbide ball

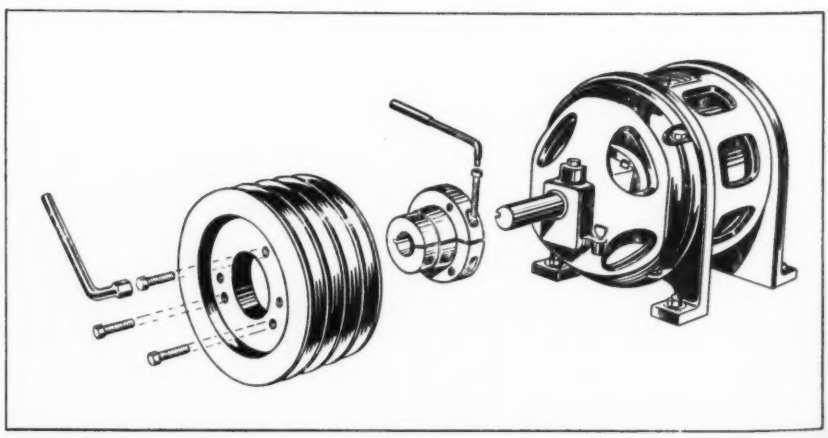


"Carbur" Burring Tools

ends. The shanks are 0.250 inch in diameter, and the length of the burring tools is 2 1/2 inches. 95

Pyott Quick-Detachable Sheaves

Quick-detachable sheaves of unusual design for multiple V-belt drives have been introduced on the



Application of Pyott Sheave to Motor Shaft

To obtain additional information on equipment described on this page, see lower part of page 210.

THERE MAY BE A SABOTEUR . . .

concealed in these boxes!

Its name is RUST. When the boys overseas ferry in boxes of metal parts to keep our armies on the move, one big question arises: "Are they rust-protected for the long drive ahead?" That's serious, and Uncle Sam realizes it fully. He has set up rigid specifications to which all suppliers must conform.

But, it's one thing to make a rust preventive merely to *meet* a specification. And it's quite another job to *beat* that specification. When you buy rust preventives, you want to be assured that the maximum "spec" is the minimum goal of the rust preventive manufacturer.

In the interest of preserving metal parts *longest* against corrosion, Houghton sets as its objective the greatest protection that can be afforded, while at the same time meeting the carefully prepared government specifications.

We use only clear, filtered oils, selected from a wide variety of stocks. These are oils of highest stability, assuring long life without chemical change. They will keep on protecting, month after month, against the ill effects of climatic changes, salt air, heat and humidity.

The result: Corrosion-free metal parts ready when needed by our armed forces all over the world, be it tomorrow or years from now.

Houghton is cooperating with governmental agencies to solve the new problems of rust prevention constantly arising in this global war. Whether or not specification products are required, our 75 years of experience is at your service.

E. F. HOUGHTON & CO.

303 W. LEHIGH AVENUE, PHILADELPHIA

CHICAGO • DETROIT • SAN FRANCISCO • TORONTO

Houghton's COSMOLINE PREVENTS RUST

market by the Pyott Foundry & Machine Co., 328 N. Sangamon St., Chicago, Ill. The ease, speed, and safety with which a Pyott QD sheave of this new line can be attached to or removed from a shaft is an outstanding feature. A socket wrench is the only tool needed.

The accompanying illustration shows the simple steps involved in attaching the sheave to a shaft. First the tapered split Pyott hub is slipped on the shaft in line with the keyway; then the headless capscrew shown is tightened with an inserted key, clamping the hub firmly on the shaft and producing a virtual press fit, even on under- or over-sized shafts. Next the sheave is attached to the tapered hub, and tightened on the hub by inserting the pull-up bolts shown, tightening them evenly with a socket wrench. These bolts protrude through the sheave and engage threaded holes in the hub. The hubs and rims are balanced separately to insure an accurate-running assembly.

The sheave can be removed from the hub by simply removing the three pull-up bolts and inserting two of them in tapped holes in the sheave. Tightening the two bolts forces the sheave off the hub easily without the use of a hammer. With this arrangement, the sheaves can be changed without injury to the shaft or motor bearings.

The QD sheaves are available in standard sizes up to 50.75 inches outside diameter, and in various styles, with from three to twelve grooves. 96

Curved Plastic Panels Made without Costly Dies

An advanced method in plastic molding makes it possible to fabricate parts and panels in cylindrical shapes, or parts having simple or compound curves, at low initial cost. The method has been developed by Theodore Moss Co., Inc., 33 Flatbush Ave., Brooklyn, N. Y., and is especially applicable to the production of parts in small quantities, where the initial cost of tools, dies, or molds would prove prohibitive. One typical product for which the new method has been used is an airplane panel which measures 27 inches in length by about 8 inches in width. Panels of this type, heretofore made of aluminum, required a steel die to form them. The thermoplastic panels are first molded flat, and while suspended in a semi-cured state, are curved in an inexpensive forming device.

Instrument for Identifying Ferrous Alloys

An electrical instrument known as the "Identometer," for identifying any ferrous alloy instantly and accurately by the use of reference specimens has been placed on the market by the Dravo Corporation, Pittsburgh, Pa. In this instrument, a sample of known composition is affixed to one of two clamps, and the specimen to be identified is fastened to the other. When the two pieces of metal are brought into contact, a lighted indicator registers on an easily read scale whether or not the two pieces are of the same chemical analysis. The machine is about the size of a small cabinet radio, and can be used in laboratories, shops, or warehouses. The simplicity of its application makes it adaptable for use by workers having no exceptional skill. Any inexperienced person can quickly learn how to operate the device.

Metal Plating of Plastics

A new process by which plastics, glass, or any non-conductor can be plated with any of the plating metals has been developed by the Precision Paper Tube Co., 2023 W. Charleston St., Chicago, 47, Ill. It is stated that this metal plating is permanent, and will not crack, chip, or peel off, even under long and severe service. Detailed information can be obtained from the company mentioned.

Army-Navy "E" Awards

The Army-Navy "E" Award has been presented or renewed to the following concerns in the machine-building and allied industries for excellence in production:

American Welding Co., subsidiary of the American Car & Foundry Co., Carbondale, Pa.

Chambersburg Engineering Co., Chambersburg, Pa.

Cincinnati Gear Co., Cincinnati, Ohio.

Divine Brothers Co., Utica, N. Y.

Philadelphia Gear Works, Inc., Philadelphia, Pa.

Reed-Prentice Corporation, Worcester, Mass.

Skilsaw, Inc., Chicago, Ill.

* * *

Westinghouse Offers Assistance to Other War Industries

As a contribution to the war production program, the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has opened a school to teach men from other industries a cotton belt-splicing technique that has already saved thousands of dollars worth of time and materials in the construction of war equipment. The use of this technique in Westinghouse plants, officials say, has increased the efficiency of machinery and released war-scarce leather and rubber for other uses. It also resulted in a saving of $12,000 the first year of its operation. Even greater savings have been realized since. The patented method, developed by a veteran Westinghouse workman, is being offered without charge to other companies for use throughout the duration of the war.

* * *

War Production Posters

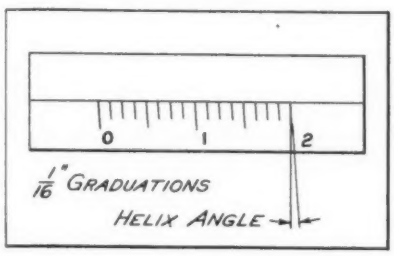
The Ordnance Department, Production Service Branch, Room 2D-381, Pentagon Bldg., Washington, D. C., has produced a poster called "Production Front Fighters' Creed." Attractively printed, these posters are available in two sizes—17 by 22 inches and 8 1/2 by 11 inches—without cost to war production plants. In requesting posters, be sure to state number of posters of each size required.

To obtain additional information on equipment described on this page, see lower part of page 210.

Method of Using Lathe for Graduating Round Stock

By LEONARD A. KROLL

The toolmaker or gagemaker often finds it necessary to mark a round or cylindrical part with accurately spaced lines similar to those on a micrometer barrel. Flat surfaces can, of course, be easily



Round Bar with Graduations Spaced by Lathe Lead-screw

graduated in a shaper or milling machine, using the micrometer dial on the feed-screw for spacing. Still greater accuracy can be obtained by moving or indexing the milling machine table by means of the dividing head and suitable gearing. Set-ups based on similar arrangements can also be used to graduate round work. Setting the lathe compound rest at an angle of 90 degrees and using the micrometer dial for longitudinal feeding or spacing is one method of handling this kind of work.

The advantages of the method to be described, which was devised by the writer, include quick set-up and operation time, simplicity, and accuracy. The lathe used for this work is set up the same as for threading, the gear ratio between the lathe spindle and the thread screw depending upon the spacing of the graduations. If sub-divisions of 1/32 inch are to be made, the proper set-up for cutting 32 threads per inch must be used. The tool employed to scribe the graduation lines is fed in and out at the points where lines are to be made, the lathe spindle, which carries the work, being revolved by hand. An indexing gear indicator or lines laid out on the chuck or driving plate should be used to insure accuracy in the length and peripheral position of the graduating lines. The lines may be started from the right or left end of the piece to be graduated, depending upon whether the lathe is set for cutting a right-hand or a left-hand thread.

It is obvious that the graduations will be as accurate as the lead-screw of the lathe, which, in most cases, will be well within the specified tolerance. Of course, the lines cut or scribed will be in the form of a helix, but the helix angle is usually negligible, as indicated by the accompanying illustration, which is made to scale. The helix angle decreases as the diameter of the piece graduated increases. The angle also decreases as the spacing of the divisions decreases.

* * *

It has been pointed out that it is better to have a woman teach new woman employes a job on a machine than it is for a man to do it. When a man teaches women, they think, "I can never do that." When a woman teaches them, they feel, "If she can do it, I ought to be able to."

New Eye-Protection Glass for Welders

Development of a new glass known as "Didymium Noviweld," which protects the eyes of gas welders and yet enables them to see welding operations from beginning to end, has been announced by the American Optical Co., Southbridge, Mass. Previously, the glare of flame-welding made it impossible for welders to see exactly what they were doing — a factor that has materially slowed up the welding of military planes, ships, tanks, etc.

In all types of flame-welding, the new "Didymium Noviweld" safety goggle lenses cut down the high-intensity sodium rays of the fluxes. Flame workers can thus look right through the yellowish cloud of "flux-flare," see the rod and the molten area more clearly, and thereby step up their efficiency in every phase of the welding operation, particularly in the flame-welding of aluminum and steel. The lenses also protect the eyes by absorbing the harmful ultra-violet and infra-red rays generated during welding.

* * *

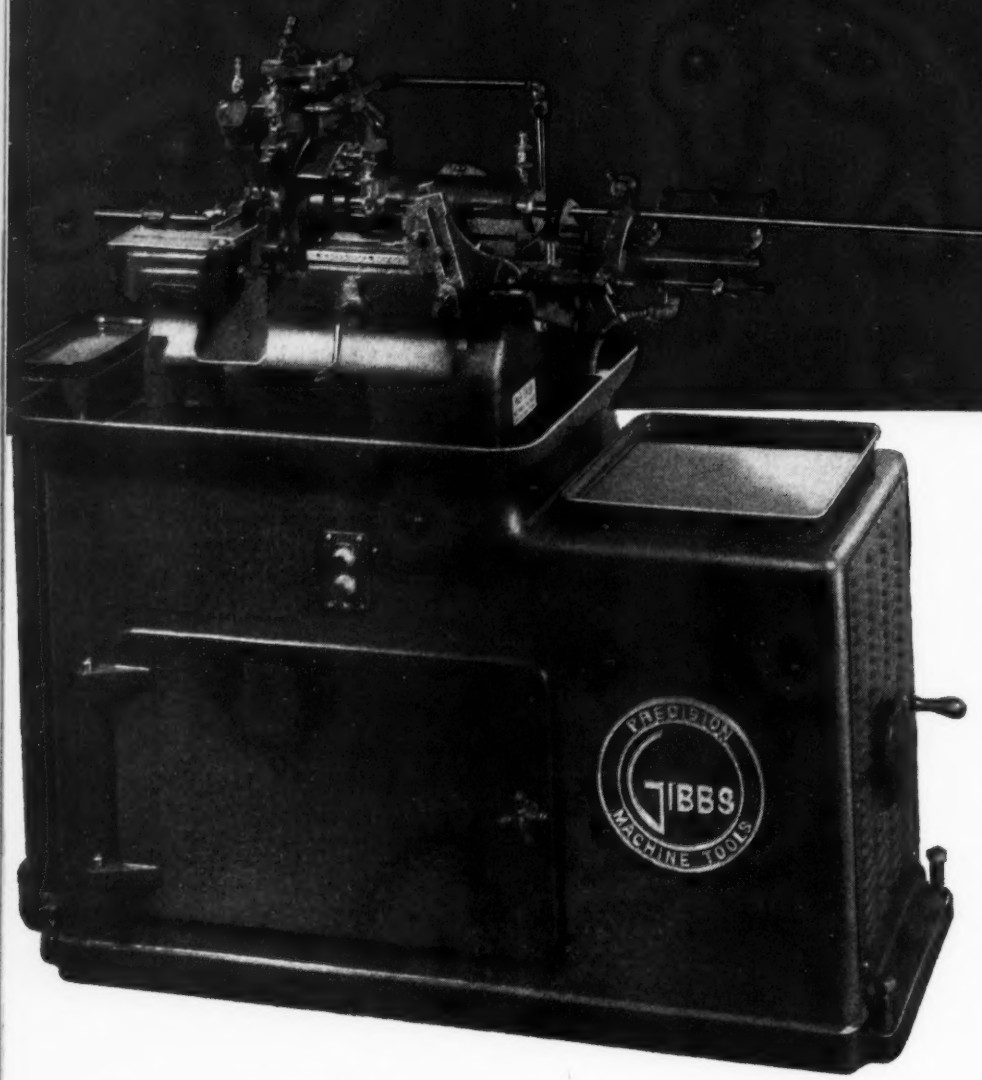
A New Application of Meehanite

According to information obtained from the Cooper-Bessemer Corporation, Grove City, Pa., Meehanite iron has replaced brass in the production of propeller castings in the foundry of this corporation. The Meehanite propellers produced for U. S. Coast Guard vessels have passed rigid inspection and tests. By the use of Meehanite, propeller costs have been reduced as much as 50 per cent, in addition to conserving brass.

This self-locking stop-nut, developed by the Elastic Stop Nut Corporation of America, Union, N. J., is designed for use in plywood construction. The stop-nut, with its red cellulose locking collar, is locked in a light-weight basket having four prongs and two feet that are forced into

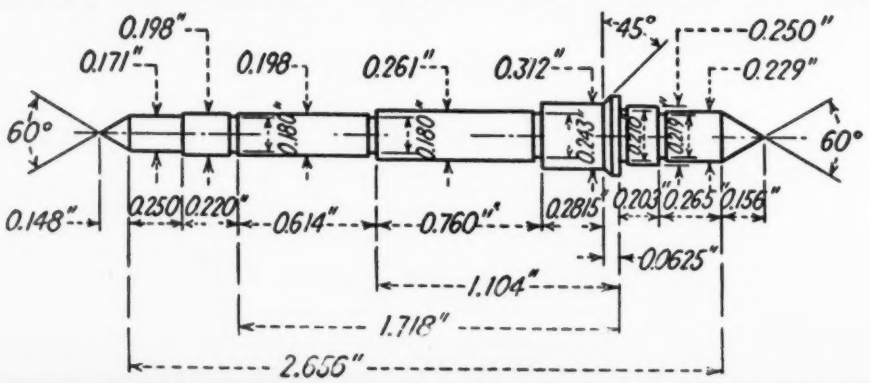
the wood as the nut descends, thus anchoring the basket firmly in place. It can be used for plywood of any thickness from 1/8 inch up. Nuts for 8-32 and 10-32 bolts can be interchanged without removing the basket after it has been applied. The baskets weigh 4 ounces per hundred.

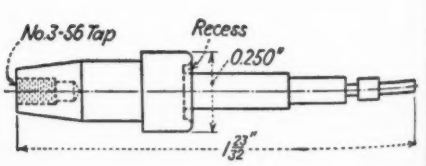
NOW the story



- ★ Automatic operation from bar stock to finished piece.
- ★ High speed (and low cost per piece).
- ★ Extreme accuracy.
- ★ High finish.
- ★ Easy to operate — safe.
- ★ 5 cutting tools and 5 attachments.
- ★ Modern — to meet your present and future production needs.

The GIBBS will do all of these operations





Submit any small piece problem to Dept. 8 . . . no obligation to you

THOMAS

DIVISION OF THE

can be told!

It's the GIBBS MODEL 375 AUTOMATIC SCREW MACHINE

YES — now the story can be told . . .

Although scores of leading manufacturers have been using the Gibbs 375 Automatic Screw Machine for some time to turn out amazingly intricate small parts in literally hundreds of different shapes . . . this is the *first time* it has ever been advertised!

In this perfected machine tool is the tailor-made answer to any problems you may have in turning out small pieces automatically, at high speed, low cost, and with only moderately skilled operators.

Turning . . . forming . . . drilling . . . reaming . . . threading . . . knurling . . . counterboring . . . undercutting . . . tapping . . . slotting . . . spotting — the Gibbs Automatic does the whole job for you with extreme precision . . . *consistently to tolerances of .0002".*

Built with 5 cutting tools and 5 attachments, the Gibbs is a high-speed machine that "walks away" from anything you have ever seen.

Here, then, is a completely *modern* automatic screw machine . . . actually a postwar machine tool NOW! That's why — if your problem is to turn out small intricate parts from bar stock — it will pay you to find out how the Gibbs 375 Automatic Screw Machine can save you time, labor, and money both *now* and in the *postwar period to come.*

GET ALL THE FACTS!

Write for booklet M-101 describing how the Gibbs 375 may help you solve your small parts problems.

"8 months — 24 hours a day of mass precision production"

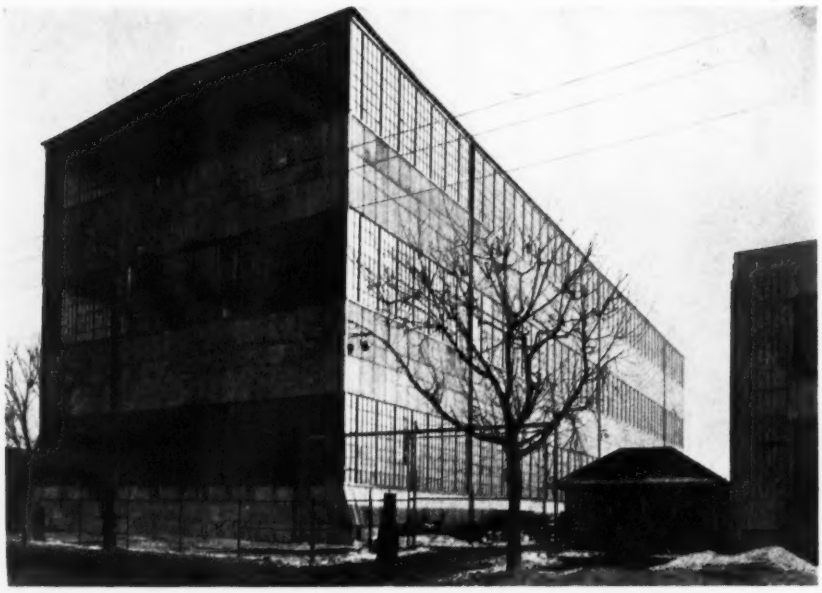
Here's what one manufacturer of precision parts writes — "Our Gibbs Automatic Lathes have now been in operation continuously in our plant for eight months. These machines are producing small precision parts requiring very close tolerances, and have given very satisfactory results over this entire period. Production has never been interrupted for mechanical repairs in spite of the fact the machines have been running 24 hours daily."

A manufacturer of watch-like parts writes — "With our Gibbs Automatics, we are not only keeping to extremely close tolerances, but we are turning out parts on a production basis, with fewer man-hours per 1,000 pieces. Your attachments certainly fill the bill for letting us do more operations. In our opinion, these attachments make the Gibbs the outstanding automatic on the market."

B. GIBBS & COMPANY

GEORGE W. BORG CORP., DELAVAN, WIS.

PRECISION GIBBS MACHINE TOOLS



Clearing Machine Corporation's New 70-foot High Assembly Plant

New Clearing Assembly Plant

The completion of a new assembly building has substantially increased the capacity of the Clearing Machine Corporation, Chicago, Ill. The new plant is 70 feet high. Future expansion has been provided for by making the back wall of a temporary character. The plant has been built specifically for assembling giant Clearing presses. The reinforced concrete floor, 24 inches thick, is capable of sustaining a load of 1,000,000 pounds as distributed over the base of a press. Two cranes with capacities of 50 and 100 tons have been installed. The distance from the crane hooks to the floor is 50 feet.

Training Course for Users of Carbide Dies

A special training course for users of carbide dies has been organized and put into operation at the Carboloy plant in Detroit to meet the need for trained die-room employes. There has been a great increase in the use of cemented-carbide dies in connection with war production. The course is designed both for new employes of carbide-die users and for more experienced die service men. It will serve to acquaint the men taking it with the vast changes and improvements in carbide dies, servicing methods, and equipment made during the last year.

Those selected for the course should preferably be men who will function in key positions in die service rooms. These men, in turn, can then train other men upon returning to their plants. All men taking the course must be citizens of the United States. The course is conducted without charge. Further information can be obtained from K. R. Beardslee, general sales manager, Carboloy Company, Inc., Detroit, 32, Mich.

* * *

Brass and Copper for Aircraft Manufacturers

A new program to assist aircraft manufacturers in placing brass and copper orders has been established by the Aircraft Scheduling Unit, with the cooperation of the brass and copper mills. The new procedure is aimed at simplifying the obtaining of materials. Complete information relating to the program can be obtained from Lieutenant Colonel A. E. R. Peterka, Materials Distribution Branch, Resources Control Section, Materiel Command, Steele High Bldg., Dayton, Ohio.

Pressed Metal Institute

The Pressed Metal Institute was recently organized by about sixty representatives of sheet and strip metal fabricators, rolling mills, and metal press manufacturers serving the industry. The newly organized Institute will cooperate closely with Government departments to speed up and increase the production of war materials, and will also engage in research to develop new and extended uses for metal stampings in the post-war period. In addition to its administrative office at 19 W. 44th St., New York City, the Institute has established an office in the Press Bldg., 14th and F Sts., N.W., Washington, D. C. George E. Whitlock, president of Mullins Mfg. Corporation, Warren, Ohio, is president of the Institute. An informative booklet is available.

* * *

Films Showing the Use of Gage-Blocks

The Savage Tool Co. has brought out four 35-millimeter sound slide films describing the use of gage-blocks. The four films require about one and one-half hours for presentation and cover the following subjects: The theory of gage-blocks; how gage-blocks are used; how gage-blocks are made; and the use of gage instruments. These films are offered for presentation before plant executives, foremen, inspectors, and trade school classes. They are lent by the company free of charge for temporary showing or can be purchased at cost for permanent use. The films are available through the local sales offices of the DoAll Co. or directly from the Savage Tool Co., Minneapolis, Minn.

* * *

Production Calculator

A production calculator consisting of a chart that simplifies the calculations for machining operations has been brought out by Crobalt, Inc., 1354 N. Main St., Ann Arbor, Mich. It will be supplied to men in the mechanical industries without charge. By means of this chart, cutting speeds, revolutions per minute, feeds, cutting time, and pieces per hour can be found.

Wide Range of Low Driving Speeds

in a Single, Compact Variable Speed Unit...

The New REEVES *Reducer-Type* TRANSMISSION

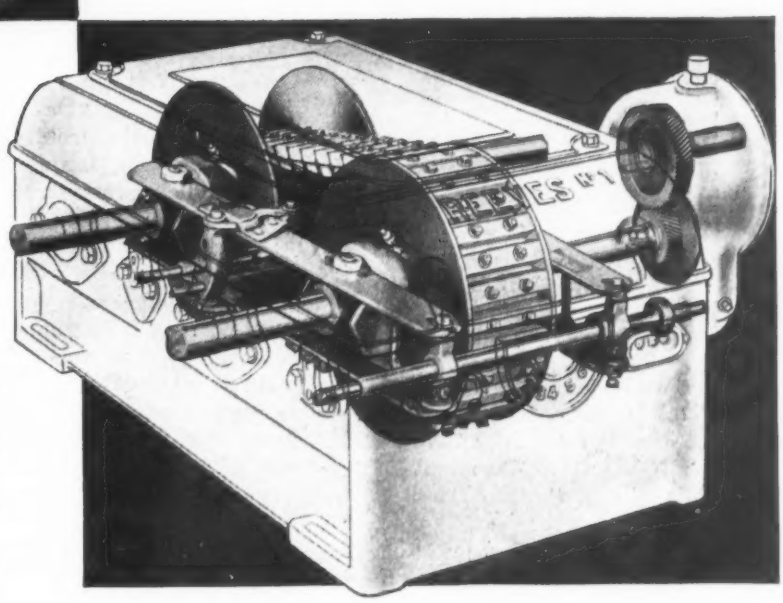
The REEVES Variable Speed Transmission —industry's widely preferred unit for providing accurate, instant speed adjustability—is now available with built-in, helical-type speed reducer.

With this new REEVES drive, speed adjustability and reduction are secured, without the use of other auxiliary speed reducing equipment, and the operator of any production machine has a wide range of low driving speeds instantly available in a single compact unit.

The REEVES Reducer-Type Transmission is offered in two completely enclosed designs—horizontal and vertical—each available in many different horse power capacities and ranges of speed variation. Both designs are highly adaptable and may be mounted in most any position to meet individual installation requirements.

It is easy to equip either design for individual motor drive by use of the REEVES adjustable motor base, as pictured above, which accommodates any available motor. Send for full details. Use handy coupon below.

REEVES PULLEY COMPANY • COLUMBUS, INDIANA



"X-ray" view showing how reduction gears are mounted on the variable speed shaft of the Transmission, this shaft serving as the input shaft for the reducer unit.

REEVES *Accurate-Variable* SPEED CONTROL

REEVES PULLEY COMPANY • COLUMBUS, INDIANA

Send copy of 16-page Catalog MTR-432 giving complete engineering information on the new REEVES Reducer-Type Transmission.

NAME OF FIRM.....

INDIVIDUAL.....ADDRESS.....

CITY.....STATE.....

A Record to be Proud of

David A. (Dad) Teeter does not even know the meaning of the word "absenteeism." Mr. Teeter, who is eighty-four years old and recently celebrated his thirty-second anniversary with Mack Trucks, Inc., Plainfield, N. J., has an enviable record. In the thirty-two years that he has been with the company he has been late only once. Mr. Teeter

David A. Teeter, Eighty-four Years Old, Still Active in War Production

has two grandsons in the Army. When the Mack Trucks' Plainfield plant received the Army-Navy "E," he accepted it in the name of the employes.

* * *

Protective Coating for the Hands

A new coating that protects the hands from the action of cutting oils, solvents, fumes, and chemicals has been brought out by the Jones Medical Laboratories, Inc., 800 Huron Road, Cleveland, Ohio. This product has already been used in many industrial plants to prevent dermatitis caused by contaminated cutting oils. The new coating is known as "Neo-Film." It comes in liquid form; when applied, it dries rapidly to form an elastic "visible glove" that is oilproof and antiseptic, but can be washed off with soap and water.

Lempco Products Twenty-Five Years Old

Twenty-five years ago, Lempco Products, Inc., started in business in Cleveland making axle shafts for automobiles in a small garage. The business was founded by James F. Strnad, president of the company, and John Y. Blazek, now secretary and general plant superintendent. The business of the company has expanded during the last twenty-five years until today it employs 600 men and women in several factories. In addition to the production of war equipment, the company today is engaged in the manufacture of various types of machine tools and expansion reamers. The company was awarded the Army-Navy "E" last December.

* * *

Cream for Removing Paint from Hands

A non-irritating, non-explosive cream, known as "Den-Tex," developed to solve the problem of removing paint and lacquer from the hands is being manufactured by the Dennis Chemical Co., St. Louis, Mo.

Paints, lacquers, airplane dopes, enamels, varnish, resin solutions, synthetic adhesives, etc., are said to yield readily to this cream. The removal of such tenacious and resistant materials from the hands in such a manner as to leave the pores open and clean and the skin soft is accomplished by merely working the cream into the material and rinsing with water.

* * *

Hot-Finished Seamless Steel Tubing

The substitution of hot-finished seamless steel tubing for cold-drawn tubing has been recommended by the Seamless Steel Tube Institute, Gulf Bldg., Pittsburgh, Pa., as a means of increasing the output of tubing to meet the demands of essential war needs. This recommendation covers the larger sizes with heavier walls that are often machined, that is, tubing 3 inches in outside diameter or larger. The Seamless Steel Tube Institute will assist tube users with necessary information.

Ink for Lay-Out Work on Dies

The DoAll Co., 1215 Thacker St., Des Plaines, Ill., has developed a new ink for use in precise lay-out work on dies, templets, and machine parts; for locating high spots in scraped machine ways; checking gear tooth contacts; and for use in fitting precision parts. A feature of this product is its quick drying property. Under average conditions, it will dry with sufficient hardness to commence lay-out work one minute after application.

It is usually very difficult to affix a thin even coat of material on ground steel surfaces, because of their smoothness and lack of open pores. Yet it is claimed that the new ink will adhere to such surfaces with tenacity. This ink is deep blue in color, and provides excellent contrast with scribed lines. It will not shrivel, chip, or crack.

* * *

A Comprehensive Employes' Handbook

The Lincoln Electric Co., Cleveland, Ohio, has published a 36-page handbook for the company's employes, giving detailed information on practically all subjects pertaining to the company and employment with the company that a new employe might wish to have. Among the special features in the handbook are sections dealing with the advisory board of employes with which company management confers; the suggestion system; the wage system; and the employes' stock purchase plan. The Lincoln Electric Co. will send a copy of this handbook to any employer who may wish to obtain one.

* * *

Gear Business Continues to Increase

The gearing industry, as represented by the members of the American Gear Manufacturers Association, Empire Bldg., Pittsburgh, Pa., announces that the business in industrial gearing booked in May, 1943 — the last month for which complete figures are available—increased 42.5 per cent, compared with April.

Now FAST DELIVERY OF ALL TYPES OF ROUND BROACHES

FROM

Colonial's NEW PLANT

ALSO *FAST* DELIVERY ON PLAIN FLAT BROACHES

In Colonial's new plant are to be found greatly increased facilities for the production of broaching machines and broaches, particularly for round and plain flat types. As a result we are currently in a position to supply all round broaches and plain flat types in a matter of weeks instead of months. And this in spite of the fact that Colonial's total volume of broaches is vastly greater than ever before and quality still higher.

1918—25TH ANNIVERSARY—1943

colonial BROACH COMPANY

Broaching Machines *Broaches-Broaching Equipment*

DETROIT . . . . . U. S. A.

News of the Industry

Canada

FRED J. WOOD has been appointed district manager of the Jessop Steel Co., Ltd., 530 Front St. W., Toronto, Canada. Born and educated in Canada, Mr. Wood, for the last twelve years, has lived in Detroit, Mich., where, in 1942, he joined the Jessop Steel Co.'s office there.

California

ALVIN "DUTCH" ZWERNEMAN, vice-president of the Axelson Mfg. Co., Los Angeles, Calif., is severing his association of twenty years with the company to become connected with the Petroleum Administration for War in Washington, D. C., under the leadership of FRANK A. WATTS, Director of Materiel. Mr. Zwerneman will have the title of Special Assistant to the Director of Materiel, and he will represent the petroleum equipment manufacturers and suppliers. His work will have to do with coordinating raw material sources for manufacturers of petroleum industry equipment. Mr. Zwerneman's position with the Axelson Mfg. Co. will be filled by KEN S. RAMEY, who will act as temporary California sales manager. Mr. Ramey has also been connected with the Axelson organization for over twenty years. His headquarters will be at the Los Angeles plant.

Colorado and Washington

BARBER-COLMAN CO., Rockford, Ill., has appointed the EDWIN C. ANDERSON CO., 1863 Wazee St., Denver, 2, Colo., distributor for the temperature control Uni-Flo products of the company in the states of Colorado, Wyoming, and part of Nebraska.

H. B. HODGINS, application engineer for the Westinghouse Electric & Mfg. Co. in the Spokane, Wash., area since 1935, has been named manager of the Spokane office of the company.

Illinois

DOMESTIC INDUSTRIES, INC., Chicago, Ill., has purchased the thirty-three-year old Siewek Tool Co., Ferndale, Mich., manufacturer of cutting tools. Two affiliated companies—the Siewek Tool & Engineering Co., Hartford, Conn., and the Progressive Tool & Cutter Co., Ferndale, Mich.—were included in the acquisition. The Siewek Tool Co. and the Progressive Tool & Cutter Co. will hereafter be operated as the Siewek Tool Division of Domestic Industries, Inc. The Siewek Tool & Engineering Co. will operate as the Siewek Engineering Division. STEPHEN I. MESZAROS is general manager of both divisions, and N. J. HOLT will continue as manager of the Engineering Division. Domestic Industries, Inc., also recently acquired the SERVICE CASTER & TRUCK CO., of Albion, Mich., and its affiliates.

JOSEPH L. MULLIN has been appointed general superintendent of foundries for the American Manganese Steel Division of the American Brake Shoe Co., Chicago Heights, Ill. He was previously works manager of the New Castle, Del., plant. W. F. KELLY, plant superintendent at New Castle, will succeed Mr. Mullin as works manager of that plant.

GRAND SPECIALTIES CO., Grand Ave. at Troy, Chicago, Ill., was presented with the Production Award on July 3 by the Chicago Ordnance District of the United States Army. Following the award ceremonies, a buffet luncheon was served in celebration of the dedication of the company's new factory building and offices.

JACK ZIMMER has been elected vice-president of the Edward Katzinger Co., 1949 N. Cicero Ave., Chicago, Ill. Mr. Zimmer became connected with the company in 1932 as tool-room foreman, and has been chief engineer for several years.

LINDSAY & LINDSAY, manufacturers of cabinets, housings, truck bodies, and other metal structures, have moved to new and larger quarters at 4825 S. Rockwell St., Chicago, Ill.

Indiana

K. L. CRICKMAN, manager of the Indianapolis branch of the Carpenter Steel Co., has been appointed regional manager of the southwestern area. His headquarters will continue to be in Indianapolis. C. H. HARTON has been made assistant branch manager of the Indianapolis territory.

FREDERIC I. LACKENS, advertising manager of the Hays Corporation, Michigan City, Ind., manufacturer of combustion instruments and control, has been elected president of the National Industrial Advertisers Association, Inc.

Michigan

JOHN TJAARDA & ASSOCIATES, 817-818 Fisher Bldg., Detroit, 2, Mich., industrial designing engineers, have made arrangements with the ACCURATE ENGINEERING CO., 5248 N. Clark St., Chicago, to handle their engineering work in connection with the development of the company's home appliances, special machinery, and other engineering projects. In July MACHINERY, page 246, it was incorrectly stated that John Tjaarda had become associated with the Accurate Engineering Co.

CHARLES E. SORENSEN, vice-president of the Ford Motor Co., Detroit, Mich., has been appointed a member of the board of directors of the Automotive Council for War Production, taking over the post left vacant by the death of Edsel B. Ford, who served continuously since the formation of the Automotive Council a year and a half ago.

C. W. MORRIS CO., manufacturer of accessories for the aircraft industry, has removed to 10628 Cloverdale Ave., Detroit, 4, Mich., where larger facilities are available.

New England

J. W. PECKHAM has been appointed manager of the development and design engineering department for the Bristol Co., Waterbury, Conn., manu-

J. W. Peckham, Manager of the Development and Design Engineering Department, Bristol Co.

You can tell

A "MICHIGAN"-SHAVED GEAR

by the noise it Doesn't make

You can take hours in putting a beautiful polish on an inaccurate gear–but it won't make that gear any more accurate.

The best test for gear quality–and that means gear life–is not how pretty it looks but HOW QUIET–accurate–it is.

And the fact is that "MICHIGAN" SHAVED GEARS *ARE* QUIETER even though you need less time, less equipment, less skill, and less money to finish a gear to the desired accuracy on a Michigan than by any other method.

Ask for the new Gear Finishing Manual #GF-43

BUY U.S. BONDS STAMPS

MICHIGAN TOOL COMPANY

7171 E. McNICHOLS ROAD . . . DETROIT, U. S. A.

E. Nuber, Newly Appointed Manager of Pacific Coast Branch of Bristol Co.

facturer of automatic control and recording instruments. Mr. Peckham was previously Pacific Coast district manager, in charge of the company's San Francisco, Seattle, and Los Angeles offices, and the San Francisco branch factory. He will make his headquarters in Waterbury, Conn. E. NUBER will take Mr. Peckham's place as manager of the Pacific Coast branch offices and factory, with headquarters at 40 Berry St., San Francisco, Calif. He was previously manager of the Akron branch office and factory.

WARREN D. ANDERSON, for over five years a member of the engineering staff of the Norma-Hoffmann Bearings Corporation, Stamford, Conn., has been made assistant to the chief engineer. FRANK L. WRIGHT, for over eleven years chief metallurgist of the company, has been advanced to the position of manager of research.

OLIVER W. BONNAFE, research engineer of the Lapointe Machine Tool Co., Hudson, Mass., has been awarded the National Metal Trades Association medal for his development of the automatic broach rifling machine. Mr. Bonnafe was born in Canada, and has been associated with the Lapointe Machine Tool Co. since 1919. The machine developed by Mr. Bonnafe has speeded up production of war material to a remarkable extent, since it does in one minute what previously required two hours to accomplish.

ALBERT A. BERTRAND has been appointed superintendent of night operations at the East Springfield, Mass., plant of the Westinghouse Electric & Mfg. Co. Mr. Bertrand has been general foreman of the war products department of the Springfield plant since April, 1942.

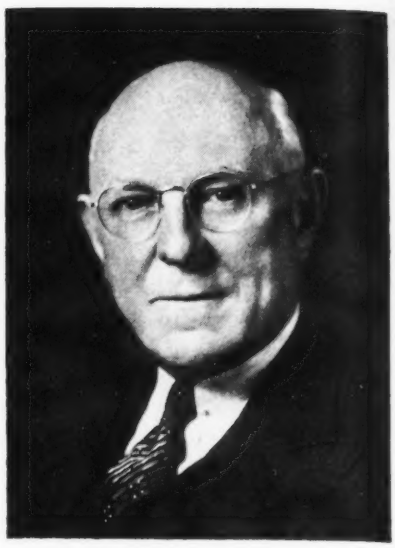
FREDERICK W. MCINTYRE, vice-president and general manager of the Reed-Prentice Corporation, Worcester, Mass., has returned to this country to resume active management of the company after spending three months in Australia as a machine tool consultant for the U. S. Lend-Lease Mission.

H. B. JAMESON has been appointed division manager in the New England territory of the Aro Equipment Corporation, with headquarters at 52 Harvard Ave., Allston District, Boston, Mass.

New York

SAM TOUR & CO., INC., with main offices at 65 Pine St., New York City, are now operating the metallurgical laboratories at 45 Fulton St. that were established by Sam Tour during the fourteen years that he was vice-president and chemical and metallurgical engineer in charge of the engineering departments of Lucius Pitkin, Inc. The latter firm will continue as analysts, assayers, chemists, and consultants to the mining and metallurgical industries, and will retain its headquarters in the Pitkin Bldg., 47 Fulton St., New York City.

WILLIAM P. WOODSIDE has resigned as vice-president in charge of research of the Climax Molybdenum Co., New York City. Mr. Woodside has been active for the last fifty years in the steel industry. He joined the Climax Molybdenum Co. in 1926, and became director of research in 1931. ALVIN J. HERZIG will take over Mr. Woodside's research duties, while still retaining



William P. Woodside, Vice-president, Climax Molybdenum Co., whose Resignation has been Announced

his position as chief metallurgist. Mr. Herzig has been with the company since 1931.

GEORGE M. WILLIAMS has joined the Curtiss-Wright Corporation in the capacity of vice-president and will assist the president in an executive capacity. He will make his headquarters in the executive offices of the corporation at 30 Rockefeller Plaza, New York City. Mr. Williams was formerly assistant to the chairman of the board of the Consolidated-Vultee Aircraft Corpn.

HENRY K. BEEBE has been made works manager of the Wales-Strippit

Oliver W. Bonnafe, Research Engineer of the Lapointe Machine Tool Co., Who was Recently Awarded a Medal by the National Metal Trades Association for his Development of the Automatic Broach Rifling Machine

WANT TO PREVENT RUST?

Some technical information of great importance to all interested in anti-corrosion coatings

BACK IN 1932, Quaker made some "rustproofing oils and greases" as did several other concerns in the country. These products were usually mineral products of varied viscosities, some of which contained chromate. They worked pretty well, but just how well no one really knew.

Protecting Aircraft Parts a Serious Problem

Then, one of the large aircraft engine manufacturers got into serious trouble, as precision parts rusted on the production line and finished motors shipped to distant points arrived in a deplorable condition due to severe corrosion.

After a preliminary survey by a Quaker Process Engineer, our research laboratory went on the job. The first thing, obviously, was to set up a method that would accurately and effectively measure the value of a rust preventive coating. Salt sprays had been used in the past but they did not give an accurate measure of what was wanted. Even salt spray tests varied widely.

New Product Developed

So, in 1932 Quaker built one of the first, if not the first, humidity cabinets designed specifically to measure semi-permanent rust preventive coatings of an oil or grease type. For the first time one could accurately compare various "slushing mediums" and measure their value under humid conditions at varying temperatures.

Thus a revolutionary type product was developed and the problem was solved for the aircraft engine manufacturer. A line of Quaker Ferrocotes was born that has a wide acceptance among the aircraft and affiliated industries.

Accurate Measuring Technique

But probably more important, a laboratory technique was developed over the next ten years which has enabled the Quaker organization to develop better and better rust preventives. Today, rust preventives are measured in new type humidity cabinets that maintain a constant flow of moist air at a temperature of 120 deg. Fahr. throughout the cabinet. Thus, test results are reproducible time and time again and are definitely tied in with actual conditions met in the field.

However, preventing rust isn't the only thing that must be measured in a good anti-corrosion coating. Cleanability in solvent or alkali as well as the type of film left on the metal after long standing are of tremendous importance.

"Ideal" Rustproofing

Today, the best type of Quaker Ferrocote gives maximum results when applied at room temperature in a liquid form. The resultant coating is a dry, wax-like film. This does not soak into paper and containers nor run away at high temperatures. It stays where it is put, leaving a rustproofed piece that is really rustproof. It is clean to handle and can be inspected and even "miked" through the film and can be readily removed, if desired.

Quaker Process Engineers are thoroughly trained in the methods and materials necessary to give maximum rustproofing results. Their experience and Quaker Ferrocotes can be admirably applied to precision parts, shells, guns, automotive products or any other metal object.

You may profit considerably by discussing your corrosion problems. There's no obligation. Just write or wire.

QUAKER CHEMICAL PRODUCTS CORP.

CONSHOHOCKEN, PA.

OTHER PLANTS: CHICAGO AND DETROIT—WAREHOUSE STOCKS IN PRINCIPAL INDUSTRIAL CENTERS

Corporation, North Tonawanda, N. Y., manufacturer of punching and notching equipment. He was previously chief plant engineer for plants and adviser to the works manager of the Brewster Aeronautical Corporation, and has had wide experience in the automobile building field.

New Jersey

H. B. HARRISON has been appointed general sales manager of the Ferracute Machine Co., Bridgeton, N. J., builder of power presses. Mr. Harrison was

H. B. Harrison, New General Sales Manager of Ferracute Machine Co.

previously associated with the Bucyrus Co. of Milwaukee, Wis., as sales engineer. Prior to that he was general manager and part owner of the J. R. Hample Co., also of Milwaukee.

FRANK H. SHAW, president of the Shaw Insulator Co., Irvington, N. J., has been given the John Wesley Hyatt Award for outstanding achievement in the plastics industry. He received the award for having developed and perfected the transfer molding of thermosetting plastics, without which the production of many intricate and delicate plastic parts for war and industrial equipment would have been impossible.

MANHATTAN RUBBER MFG. DIVISION OF RAYBESTOS-MANHATTAN, INC., Passaic, N. J., has been awarded for the third consecutive year the first prize for the best business paper advertising campaign by the National Advertising Agency Network. The company also received second award in the Employe Relations section. The theme of the winning campaign was conservation of mechanical rubber products.

Ohio

MOSLO MACHINERY CO., Cleveland, Ohio, designer and builder of special machinery, recently held a demonstration of a new and complete welding-rod processing plant, previous to the plant's being shipped to a foreign government to speed allied war production. The plant was on exhibition for a period of ten days, and was run completely each day during the show.

WALLACE W. LEIPNER has been appointed acting chief engineer of the American Welding & Mfg. Co., Warren, Ohio. He joined the company in 1941 as assistant to the vice-president in charge of engineering. VERNE WILDMAN has been promoted to the position of assistant superintendent of the company. He was previously general foreman of the machining department.

J. S. LONGDON, sales manager, and FRANK J. SCHWAB, factory equipment manager, of Lempco Products, Inc., Bedford, Ohio, have been elected vice-presidents of the organization. Mr. Longdon has been connected with the Lempco organization for ten years, and Mr. Schwab for fifteen years.

JAMES G. GAMMEL, formerly industrial brush representative of Osborn Mfg. Co. in the New England territory, has been promoted to the position of technical assistant in brush engineering service at the home office and factory of the company in Cleveland, Ohio.

BEVIS MACHINE CO., Middletown, Ohio, was recently presented with the Maritime "M" Award for outstanding achievement in the production of propulsion shafts for Liberty ships and other heavy marine equipment.

DEWEY C. HARVEY has been promoted to the post of chief plant engineer of the Osborn Mfg. Co., Cleveland, Ohio, manufacturer of industrial brushes and foundry molding machines.

C. B. COOK has been appointed vice-president in charge of advertising, sales promotion, and export sales for the Elwell-Parker Electric Co., Cleveland, Ohio.

Pennsylvania and Maryland

JESSOP STEEL CO., Washington, Pa., announces the addition of a new technical sales staff specializing in individual classes of materials. JOHN R. HARBAUGH, metallurgical sales engineer, will deal chiefly with the metallurgy involved in special applications of alloy tool and die steels. H. E. DOUGHTY, assistant general sales manager, will specialize in high-speed tool steels. R. P. J. MCCARTY has been appointed stainless steel representative for the New England, New York, Buffalo, and Philadelphia territories. W. E. WILSON will specialize in stainless steel. JOHN WALKER has been selected to serve as special composite steel representative. E. H. DAU will serve as special sheet and plate representative, exclusive of solid stainless and stainless-clad steels.

DEAN HARVEY, materials engineer with the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., was elected president of the American Society for Testing Materials at the recent annual meeting in Pittsburgh, to serve a one-year term. Mr. Harvey has been vice-president of the society for the last two years, and succeeds H. J. BALL as president. JOHN R. TOWNSEND, material standards engineer for the Bell Telephone Laboratories, Inc., New York City, was elected vice-president.

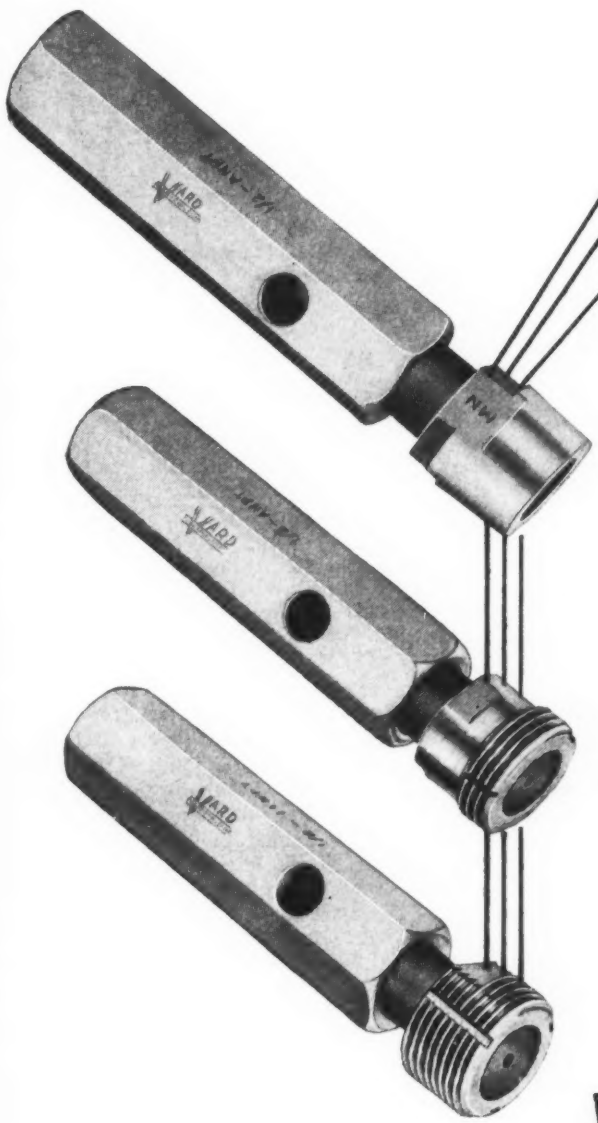
GEORGE M. MUSCHAMP has been elected vice-president in charge of engineering, and PAUL L. GOLDSTROHM vice-president in charge of production of the Brown Instrument Co., Philadelphia, Pa. Mr. Muschamp has been with the organization for twelve years, and has been in charge of engineering for the last three years. Mr. Goldstrohm has been with the company twenty years, and has been assistant general manager for two years.

C. T. HANSEN & CO., for twelve years representatives in Detroit, Mich., of the Lukens Steel Co. and subsidiaries, Coatesville, Pa., have been appointed Pacific coast sales representatives, with offices at 530 W. 6th St., Los Angeles, 14, Calif.; 235 Montgomery St., San Francisco, 4, Calif.; and 1319 Second Ave., Seattle, 1, Wash.

H. K. PORTER CO., INC., Pittsburgh, Pa., has purchased the Quimby Pump Co., with plants at Newark and New Brunswick, N. J. The Quimby plants, which manufacture a full line of pumps, including screw, centrifugal and rotex types used in industry, will be operated as divisions of the H. K. Porter Co.

EDGAR S. HUTTON has been elected treasurer of the Chambersburg Engineering Co., Chambersburg, Pa., manufacturer of forging and pressing equipment, succeeding S. L. PETERMAN, JR., who has resigned. Mr. Hutton was formerly with Clarke-Harrison, Inc., Philadelphia, Pa.

HOMESTEAD VALVE MFG. CO., INC., Coraopolis, Pa., and its employes have



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If you are manufacturing or are assembling units in which there are pipe connections threaded to the Army-Navy Specification, AN-GGG-P-363, you will need accurate pipe plug gages.

These VARD Pipe Plug Gages will quickly check the Major and Minor Diameter of internal threads, the thread form and truncation as well as lead and minimum length of threading.

VARD Pipe Plug Gages are made to American Gage Design standards and the Army-Navy Specification. They may be obtained in a full range of sizes 1/16th-inch to 6-inches diameter. All VARD Pipe Gages are made of selected tool steel, hardened, ground and finished to the specified tolerances.

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Special Taps • Snap Gages • Lathe Compounds • Dividing Machines • Aircraft Hydraulics • Aircraft Geared Parts • Course Plotters • Precision Ground Optical Lenses & Filters

again been honored by the U. S. Maritime Commission in being awarded a gold star for its Maritime "M" pennant, signifying continued outstanding achievement in the production of vital war products.

R. W. GEMMELL has been named manager of the Aviation Section, Industry Engineering Department, of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. W. A. MECHESNEY has been made manager of the Aviation Section under the Industrial Department.

JOHN W. THOMPSON, for the last four years Cleveland district representative of the Carpenter Steel Co., has been appointed assistant manager of alloy steel sales. Mr. Thompson is now located in the company's general offices at Reading, Pa.

AIR REDUCTION CO., 60 E. 42nd St., New York City, has been awarded the Maritime "M" award by the United States Maritime Commission. The award was made on July 17 at the Air Reduction Oxygen Plant, Bethlehem, Pa.

KELLETT AUTOGIRO CORPORATION, Philadelphia, 43, Pa., has resumed its original name of the KELLETT AIRCRAFT CORPORATION as being more expressive of the diversity of activities of the organization.

ROBERT N. YATES has been appointed sales manager of the Erie Foundry Co., Erie, Pa. He has served in the sales department of this concern for several years.

VICTOR H. MANTZ has been appointed assistant to the secretary and treasurer of the Allegheny Ludlum Steel Corporation, Brackenridge, Pa.

E. A. KOETHER, works manager of the Koppers Co., American Hammered Piston Ring Division, Baltimore, Md., has been made technical assistant to ALLEN W. MORTON, vice-president and general manager of the division. EDGAR S. FREEMAN, JR., assistant sales manager, will take over Mr. Koether's duties as works manager.

* * *

There is... a general feeling that widespread unemployment and want are not inevitable conditions.... The lesson of the present war should be that our economic and industrial mechanisms can be so used as to maintain our productivity far above the pre-war levels, to provide employment for all who want to work, and to avoid violent fluctuations in business activity.—*Stevenson, Jordan & Harrison, Inc.*

Obituaries

William E. Sykes

William E. Sykes, well-known authority on gears, and inventor of the Sykes continuous-tooth herringbone gear and the Sykes gear generating machine, died on June 19 in England. Mr. Sykes was formerly associated with the Farrel-Birmingham Co. at its Buffalo plant, but for the last six years had been in England operating his own plants under the name of W. E. Sykes, Ltd.

Mr. Sykes was born in England and received his technical education at Leeds University. After graduating from Leeds, he spent five years in acquiring a knowledge of practical engineering and manufacture in one of the world's largest gear plants. During that period, he worked in all the departments of the business, but specialized in engineering and research. In 1908, he was appointed factory manager of another large gear plant in England, and subsequently was promoted to the position of chief engineer and general manager. His experience in these positions covered a period of fourteen years, during which he designed and supervised the manufacture of a great quantity of new machinery and equipment.

In 1923, he joined the Farrel-Birmingham Co., who acquired the American rights to the Sykes process of gear generation. At the company's Buffalo plant, his entire efforts were devoted to the development of the Sykes gear machine and to promoting the use of the machine and the Sykes continuous-tooth herringbone gear.

As an inventor Mr. Sykes was notably successful. Over one hundred patents were issued to him. His discoveries in kinematics aroused considerable interest in the scientific world. His original one-tooth pinion model has received world-wide attention. The original has been deposited in the British Museum and replicas of it in national museums of many other countries. He was the author of numerous technical papers which were presented before many engineering societies and widely published. In 1934 Mr. Sykes was awarded the Edward Longstreth Medal by the Franklin Institute of the state of Pennsylvania, in recognition of his accomplishments in the field of gear design, manufacture, and application.

Some years ago, while still in this country, Mr. Sykes organized a company in England to manufacture Sykes gear-cutting equipment. This business rapidly grew into a successful enterprise, and in 1937, Mr. Sykes returned to England to devote his entire time to operating it. However, he retained a connection with the Farrel-Birmingham Co. as consulting engineer.

The war brought heavy demands upon the company and Mr. Sykes personally, and the strain resulted in an impairment of his health. With the hope that a rest would enable him to regain his health, he retired from active direction of his business, but the end came about three weeks later. He is survived by his wife.

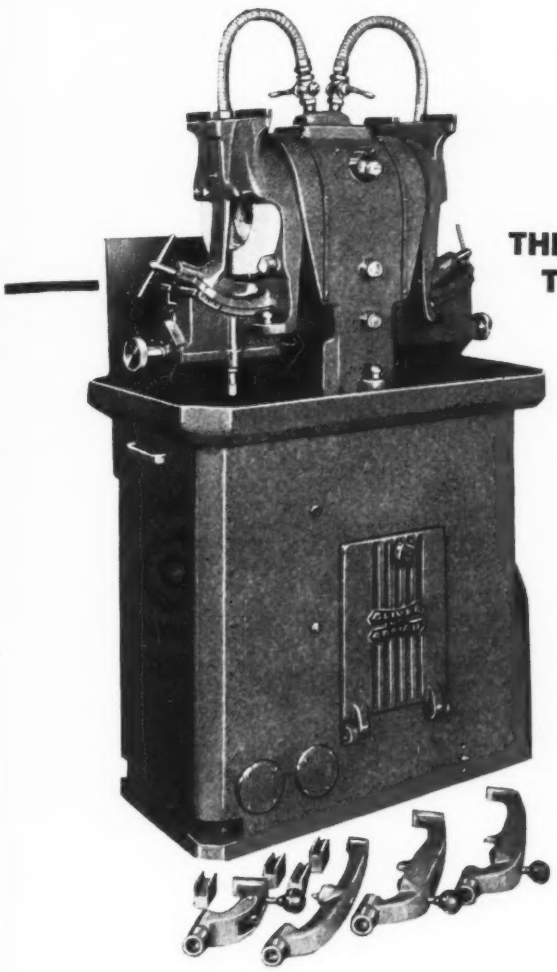
Zechariah Chafee

Zechariah Chafee, president of Builders Iron Foundry, Inc., Providence, R. I., for more than forty years, died on July 8 at his home in Taunton, Mass., aged eighty-four years. Mr. Chafee was a graduate of Brown University, class of 1880, and had been very active in the affairs of the university for more than sixty years. In 1927, he was elected a permanent trustee and member of the board of fellows.

He was born in Providence on April 29, 1859. Upon graduation from college, he entered his father's business—the Builders Iron Foundry. In 1889, upon the death of his father, he became president of the company, an office he held until his death. Throughout his long business career, he endeavored to make his business a constructive force in the community and to serve faithfully all connected with it, whether as stockholders, customers, suppliers, or employes. He took especial pride in the steadiness of employment furnished by his company and in the manner in which it changed its lines of manufacture to conform with changing conditions.

In addition to his activities in his own business, Mr. Chafee was connected with the Brown & Sharpe Mfg. Co. from 1887 to 1897, at one time being secretary of the company, and was

AIRCRAFT BUILDERS CHOOSE OLIVERS FOR SPECIAL TOOLING ON PROPELLER PRODUCTION



THE OLIVER TEMPLATE TOOL BIT GRINDER

It is no mere chance that the Oliver Template Tool Bit Grinder is being widely utilized by aircraft builders to assure the maximum efficiency of cutting tools employed in the intricate machining of Airplane Propellers. Work on these precision parts calls for cutting tools to be kept at peak performance—keen, accurate, free-cutting. And more and more aircraft producers are finding the Oliver Template Tool Bit Grinder the solution to this problem.

By means of a master template, this Oliver Grinder can produce, rapidly and accurately, the correct contour of any single-point tool, giving correct top rake, accurate clearances and sharp cutting edges. Oliver built-in precision assures correct, uniform results even with comparatively unskilled operators.

Investigate the advantages of the Oliver Template Tool Bit Grinder for keeping **your** tool bits and forged tools in top condition for high production on whatever type of vital war jobs you are turning out!

Don't Neglect Your Toolroom It's the Backbone of Production!

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AUTOMATIC DRILL GRINDERS—TOOL AND CUTTER GRINDERS—DRILL POINT THINNERS—TEMPLATE TOOL GRINDERS—FACE MILL GRINDERS—DIEMAKING MACHINES

also interested for many years in the Barstow Stove Co. He brought the Venturi meter manufacture to Providence and built up the grinding machine line sold under the name of the Diamond Machine Co. For three years he served as director of the old Bank of America, and had also served as director of the Mechanics Savings Bank, Industrial Trust Co., First National Bank, and Union Trust Co., of Providence. He took an active part in the civic and charitable work of his community.

Mr. Chafee was married on February 10, 1885, to Mary Dexter Sharpe, who died in 1934. They had four sons and two daughters.

Coming Events

SEPTEMBER 30-OCTOBER 2—Aircraft Engineering and Production Meeting of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Biltmore Hotel, Los Angeles, Calif. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

OCTOBER 18-21—Twenty-fourth annual meeting of the AMERICAN WELDING SOCIETY at the Hotel Morrison, Chicago, Ill. For further information, address the American Welding Society, 33 W. 39th St., New York City.

OCTOBER 18-22 — Annual meeting of the AMERICAN SOCIETY FOR METALS at the Palmer House, Chicago, Ill., in conjunction with the twenty-fifth annual National Metal Congress. W. H. Eisenman, national secretary, American Society for Metals, 7301 Euclid Ave., Cleveland, 3, Ohio.

DECEMBER 6-11—NINETEENTH EXPOSITION OF CHEMICAL INDUSTRIES at the Madison Square Garden, New York City. For further information, address International Exposition Co., 480 Lexington Ave., New York City.

JANUARY 10-14, 1944 — Annual meeting and engineering display of the SOCIETY OF AUTOMOTIVE ENGINEERS at the Book Cadillac Hotel, Detroit, Mich. John A. C. Warner, secretary and general manager, 29 W. 39th St., New York City.

* * *

You cannot strengthen the weak by weakening the strong, nor can you help small men by tearing down big men. The future, like the past, must be built by men with the courage of pioneers.

New Books and Publications

INDUSTRIAL RADIOLOGY — X-RAYS AND GAMMA RAYS. By Ancel St. John and Herbert R. Isenburger. 298 pages, 6 by 9 inches; 103 illustrations and diagrams. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York City. Price, $4.

This is the second edition of a book originally published in 1934. An urgent need for bringing this material up to date prompted the present revision. The title of the book was also changed from "Industrial Radiography" to "Industrial Radiology" to indicate the fact that visual inspection of materials has now become an accomplished fact. The term "radiology" includes both radiography and fluoroscopy. It has been the purpose, in preparing this book, to present the practical aspects of industrial radiology in a form and language that can be understood by students, laymen, and engineers who desire to obtain some useful knowledge of the basic theories involved. No attempt has been made to produce a scientific treatise or a comprehensive work covering all present theory. The revised edition contains much new material on equipment and accessories, and describes the latest developments and improvements in tools and technique.

FUNDAMENTALS OF ELECTRICITY FOR THOSE PREPARING FOR WAR SERVICE. By Wynne L. McDougal, Richard R. Ranson, and Carl H. Dunlap. 388 pages, 5½ by 8½ inches. Published by the American Technical Society, Drexel Ave. at 58th St., Chicago, Ill. Price, $2.

This textbook has been prepared as a primary course in the fundamentals of electricity and its applications. A comprehensive idea of the contents of the book is best furnished by listing the various chapter headings: Electricity and Magnetism; Electron Theory; Elementary Circuits; Primary and Storage Batteries; Ohm's Law; Series and Parallel Circuits; Direct-Current Meters; Alternating-Current Meters; Measurement of Resistance; Electrical Power Measurements; Induced Currents; Principles of a Generator; Types of Direct-Current Motors; Electrical Symbols; Abbreviations Used on Controller Diagrams; Dictionary of Electrical Terms; Tables; and Electrical Formulas.

MECHANICAL WORLD YEAR BOOK (1943). 260 pages, 4 by 6 inches. Published by Emmott & Co., Ltd., 78 Palatine Road, Manchester, 20, England. Price, 2/6.

This is the fifty-sixth year of publication of this little handbook on mechanical engineering. In the 1943 edition, a new section has been added on light metals and alloys, owing to the important part these materials play in modern warfare and the stimulus given to their development by the pressure of wartime conditions. In view of the importance also of press work, this section of the book has been revised, largely rewritten, and enlarged. Another timely section of the book is that dealing with the selection and substitution of processes. Useful information on die-casting and on plastics is also to be found in this section. The remainder of the volume has been revised, and recent data are included in the tables of speeds and feeds of certain types of cutting tools.

METALWORK TECHNOLOGY AND PRACTICE. By Oswald A. Ludwig. 397 pages, 8 by 10½ inches; 662 illustrations. Published by McKnight & McKnight, 109 W. Market St., Bloomington, Ill. Price, $4.

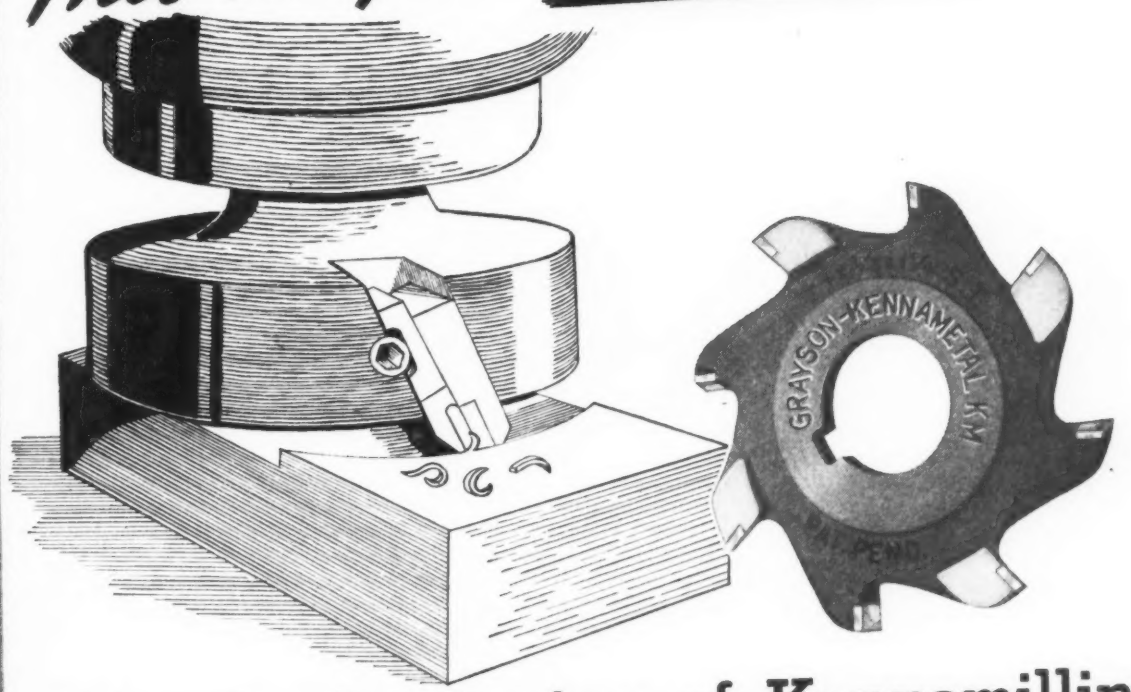
This manual comprises an introductory course to the metal trades. It describes the tools, materials, and operations common to many metal-working occupations, including all machine shop trades, automotive and aeronautical work, metal patternmaking, foundry work, sheet-metal trades, metal-building trades, ornamental metal work, electrical trades, and all industrial manufacturing. It covers hand tools; bench work and power saws; metals; care of equipment; drill press work; threads, dies and taps; assembling; sheet-metal work; art metal work; forging; casting; tool sharpening; metal finishing; inspecting; lathe work; and metal spinning.

A.S.T.M. STANDARDS ON COPPER AND COPPER ALLOYS. 385 pages, 6 by 9 inches. Published by the American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa. Price, $2.25.

This book gives all A.S.T.M. standards on copper and copper alloys, covering cast and wrought material, alloys used for electrical conductors, and nonferrous metals used in copper alloys. More than eighty-five standards are included. These specifications are widely used throughout industry and by the Government in connection with the war effort. An important feature of the publication consists of emergency alternate provisions and emergency specifications to aid in expediting procurement. Another valuable feature is the section on standard test procedures.

★ SECOND IN A SERIES ★

This simple KENNAMETAL *cutter*



Was the beginning of Kennamilling and a NEW ERA of MILLING STEEL

KENNAMILLING, variously called "Hyper-milling" or "Super-milling", was begun when this simple cutter began to skid chips from hard aircraft steel.

Until 1940 the milling of steel was confined to the slower, high speed steel cutting tools. With the introduction of **KENNAMETAL**, however, with its inherent transverse rupture strength and non-galling properties, efficient milling of steel became possible. The strength and hardness of **KENNAMETAL** steel-cutting carbides now have been combined with the rugged Meehanite bodies of **GRAYSON** milling cutters to form the **GRAYSON-KENNAMETAL** shock-resistant milling cutters, designed for maximum production on milling operations on all metals.

The cutter illustrated—with only one cutting tool—replaced an eight-flute high speed steel mill, stepped up the cutting speed from 80 rpm to 323 rpm, and increased the table feed per minute from ½" to 3-½".

This single **KENNAMETAL** cutter produced as many pieces per grind as the eight-flute high speed steel mill, but in only one-seventh the time. During the job, even more time was saved on grinding than on cutting.

KENNAMETAL milling cutters, like **KENNAMETAL** boring and turning tools, produce more finished parts per machine per day.

Write for information about **KENNAMILLING** and solve your milling problems.

KENNAMETAL *Inc.*

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THE All America CARBIDE

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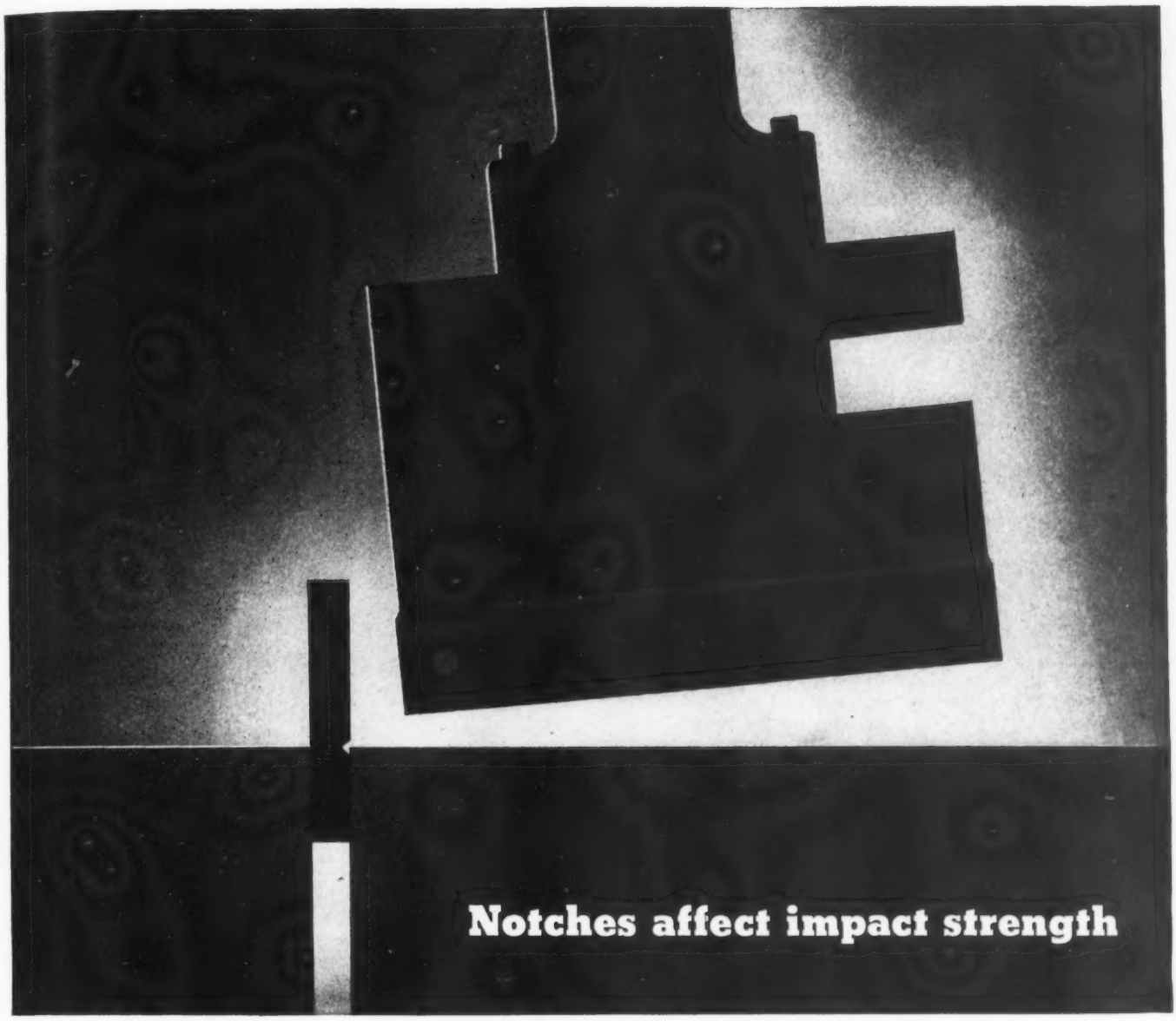
Your Progress Depends Upon Your Knowledge of Your Industry



Information supplied by an Industrial Publication

The effect of fillet radius on the life of machine parts operating under alternating stress has been known for a long time. The knowledge has been put to good use in designing parts so as to avoid fatigue failures.

The effect of variation in the notch radius of Izod impact bars has shown the way towards the elimination of impact failures in filleted parts.

Two sets of standard size impact bars were machined from one heat of steel, both with a 45° notch. In one set the notch radius was 0.01 inch and in the other 0.05 inch. After quenching, and in some cases tempering, the bars with 0.05 inch radius consistently showed about 140% improvement in impact strength.

The practical application of these results, which consisted of increasing the existing fillet radius, has eliminated impact failures in a part where the problem had become serious.

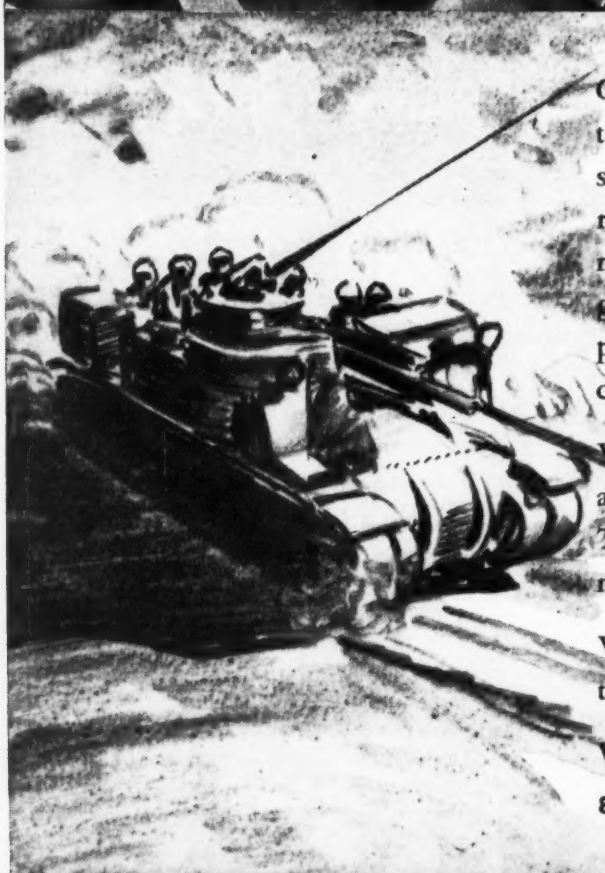
CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.

ARMY E NAVY

MOLYBDIC OXIDE, BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Mo-lyb-den-um Company
500 Fifth Avenue • New York City

MOLY



Geared to high speed and fast action, America's new tank-busters rip into the enemy's crack tank columns, smashing their most powerful tanks and putting them to rout. Not once, but many times during the past few months has this happened. These tank-busters depend greatly upon accurately made gears for their speed and performance. Such gears can be accurate only when checked against precision-built master gears.

VINCO Master Gears are carefully controlled through all stages of manufacture from design to final inspection. They represent the ultimate in the art of precision manufacture of spur, helical and worm gears.

VINCO's long experience in precision is at your service in the solution of your war or post-war production problems.

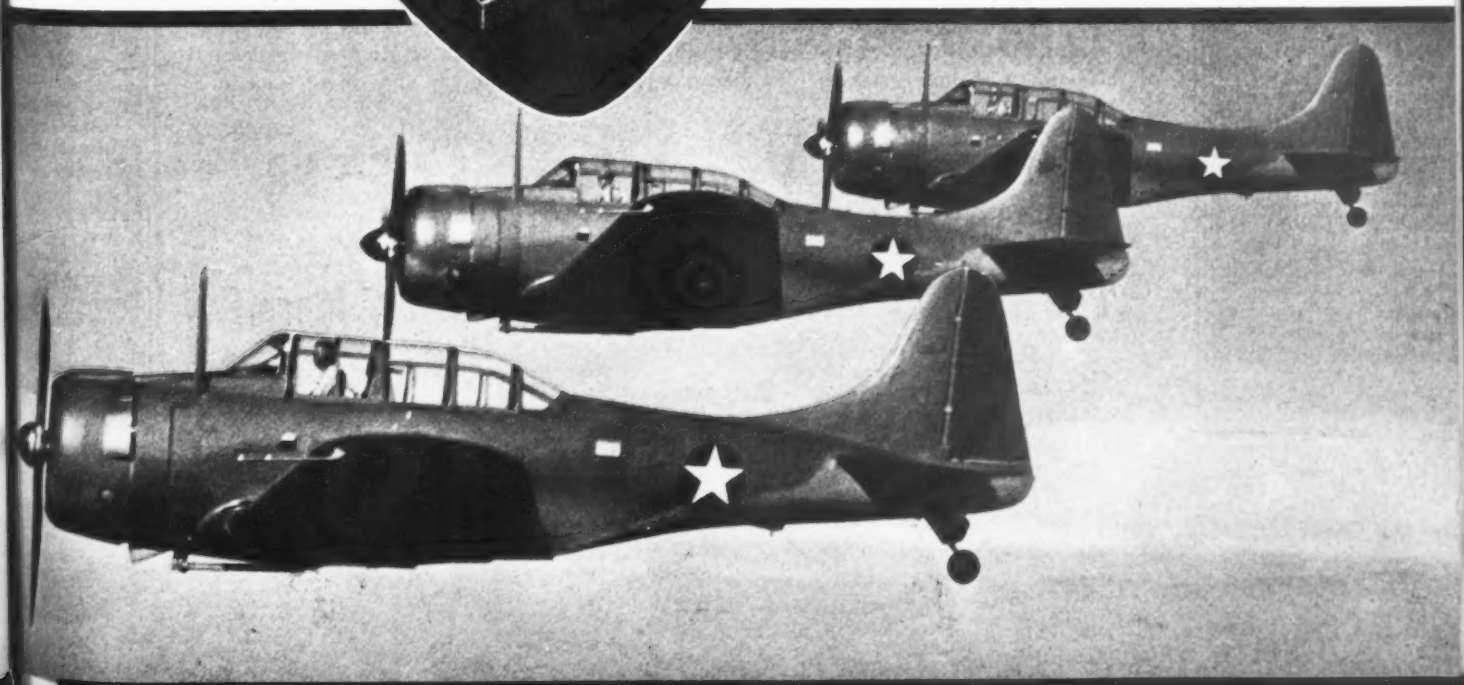
VINCO CORPORATION

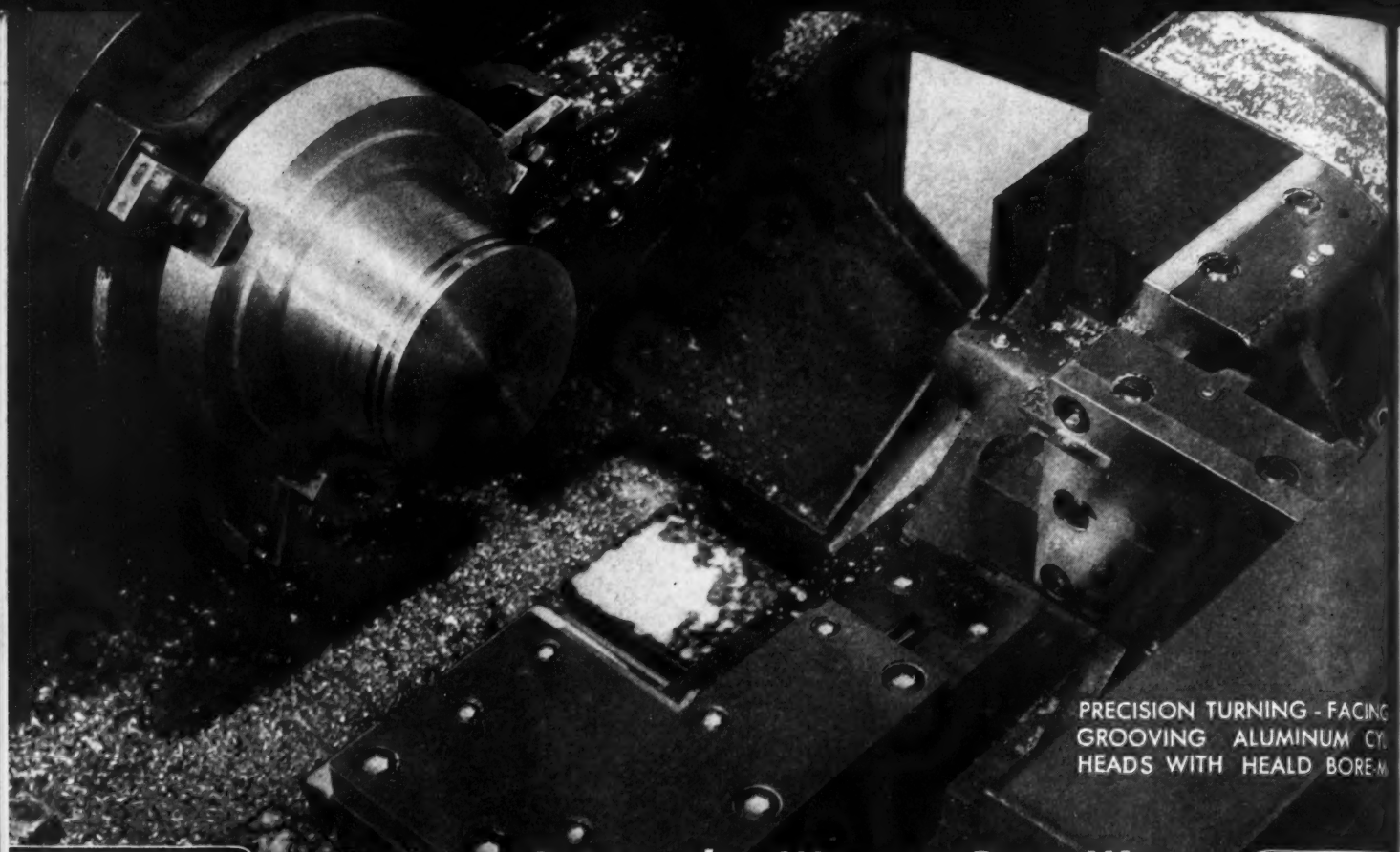
8853 SCHAEFER HIGHWAY • DETROIT 27, MICHIGAN, U. S. A.

MILLIONTHS OF AN INCH FOR SALE BY VINCO

Check Thompson

...for the precision, speed and adaptability to rough or finish grind vital war equipment and "close-tolerance" aircraft parts at the top rate of production! Illustrated above is a recent action photograph of a Thompson High Speed Surface Grinder taken at one of the Nation's better known western Aircraft plants. It shows the setup for mass-production grinding of the yoke ends of aircraft terminal forgings. Width across the ends must be held to close limits and the output remains consistently high at the rate of (censored) parts per minute. For sensitive, streamlined production of this type... for high speed, accurate war-production grinding of ANY type, check Thompson! Full details upon request to The Thompson Grinder Co., Springfield, Ohio.





Borizing Points the Way to Post War Precision Finishing of Light Metals

BORIZED ALUMINUM AND MAGNESIUM AIRCRAFT PARTS

★

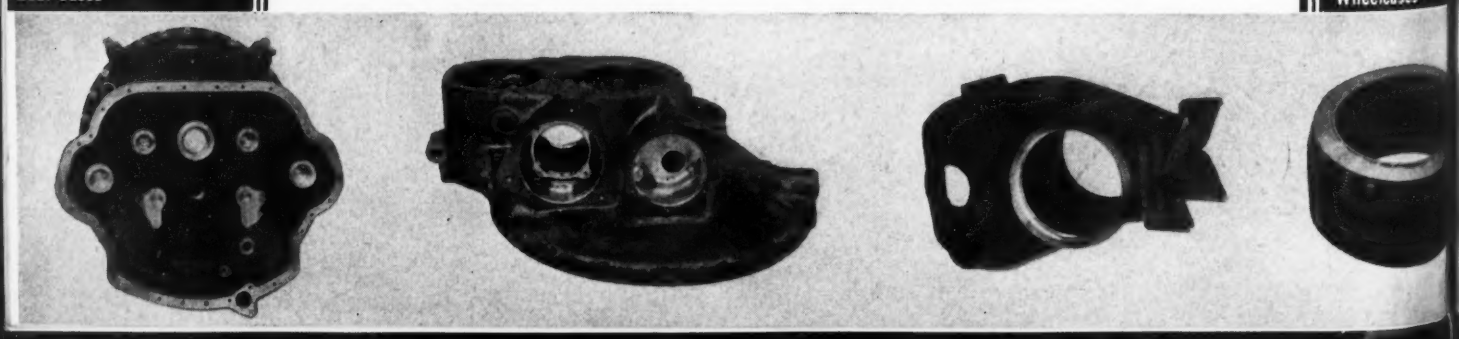
Adapter Assemblies
Bases
Bearing and Pump Casings
Bearing Housings
Bearing Supports
Boost Control Housings
Camshaft Brackets
Camshaft Housings
Caps
Carburetor Bodies
Carburetor Main Bodies
Clutch Selector Housings
Covers
Cylinders
Cylinder Heads
Cylinder Muffs
Crankcase Assemblies
Crankcase Sections
Crankcase Blower Sections
Crankcase Front Sections
Crankcase Center Sections
Crankcase Covers
Crankcase Rear Covers
Intermediate Crankcases
Intermediate Rear Crankcases
Lower Half Crankcases
Rear Crankcases
Crankcase Bearing Caps
Crankpin Oil Plugs
Crankshaft Oil Plugs
Drive Shaft Supports
Front Bearing Caps
Front Covers
Fuel Pump Bodies
Fuel Pump Drive Shafts
Gear Boxes
Gear Cases

What can be accomplished with light metals such as aluminum and magnesium, and indicative of what will be done with these alloys in post-war manufacturing, has already been shown by the aircraft industry. Approximately 40 per cent of the aircraft engine is comprised of light metals, and largely because of this it has been possible to reduce the horsepower-weight ratio to 1 lb. per horsepower.

Just as valuable as the aircraft industry's lesson to the post-war world on the use of light metals are the lessons to be learned from their methods and practices in machining aluminum and magnesium. Their methods of finishing parts made of these metals deserves particular attention. Study of their processes reveals the outstanding fact that *borizing*, or precision boring, turning facing, and grooving with cemented carbide or diamond tools, is used almost exclusively for precision finishing of aluminum and magnesium. The partial list of aircraft parts given herewith is eloquent testimony of this—all of them are made of either aluminum or magnesium and all of them are *borized*.

For More Precision, FASTER
bring your problems to
The HEALD MACHINE CO., Worcester, Mass.

Generator End Sh
Gun Turret Gimb
Gun Turret Saddle
Gyro Pilot Pump
Gyro Pilot Servo
Housings
Hydraulic Cylinde
Instrument End
Magneto Adapter
Magneto Gear
Magneto Housing
Motor End Shield
Oil Pumps
Oil Pump Bodies
Oil Pump Covers
Oil Pump Scaveng
Pistons
Plates
Pump Housings
Propeller Domes
Propeller Shaft Ba
Propeller Shaft Pi
Rear Cam Suppor
Rear Reduction G
Reduction Drive S
Reduction Gear C
Regulator Covers
Regulator Housing
Selsyn Motor Par
Shock Absorber F
Speed Reducer
Supercharger Bea
Supercharger Fro
Supercharger Gea
Supercharger Rea
Supercharger Rea
Valve Brackets
Valve Housings
Valve Guides
Valve Tappet Gui
Volute Casings
Water Pump Cas
Wheelcases



Announcing:

A brochure on Gulf Super-Quench

Send this Coupon for your copy

Just off the press, this new brochure contains 16 pages of information on the properties and advantages of Gulf Super-Quench, the revolutionary new dual-action quenching oil developed by Gulf, which has produced such outstanding results in the heat treatment of many types of steel used in the manufacture of war materiel. Send the coupon below for your copy of this interesting publication.

GULF OIL CORPORATION · GULF REFINING COMPANY

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3800 Gulf Building, Pittsburgh, Pa.
Please send me, without obligation, a copy of the new brochure, "Gulf Super-Quench."

Name .....

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Obtain your MRO requirements through your Authorized SKF Distributor. He will save your time and dollars—help keep your machines producing 24 hours a day—because he knows antifriction bearings and their application. If he doesn't have the bearing you want, he can probably suggest a substitute which will do until he can get the right one. And, since he's familar with the antifriction bearing delivery situation through his frequent contacts with us, he can utilize *his* knowledge to *your* advantage . . . help *you* keep 'em rolling. 5346

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SKF INDUSTRIES, INC., PHILA., PA.

STEELS that give form to metal—forging, pressing and stamping an endless flow of parts . . . Steels that cut and finish to sharp precision the vital units in our fighting planes . . . superior *Tool Steels* that contribute to aerial victory, and to the winning of the war on *every* front.

Official U. S. Navy Photograph

Vanadium-Alloys
STEEL CO. LATROBE, PA.

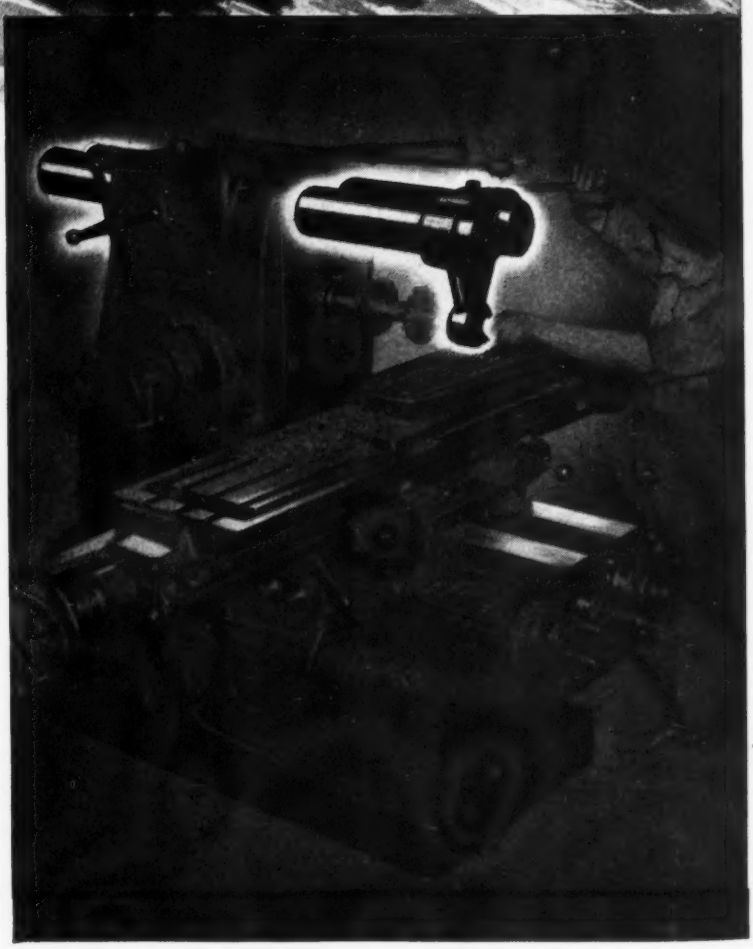
Streaking through the water at speeds of 60 miles an hour, PT Boats pack more speed and hitting power for their size than any other naval craft afloat. Their capacity to deal death and destruction — like a thunderbolt — makes them one of Uncle Sam's most feared killers of the sea.

★ ★ ★

Double Over-Arms Provide a DUAL ADVANTAGE in Milwaukee Milling Machines

Rigidity and convenience—the Milwaukee double over-arm — scores heavily on both counts . . . No other means of arbor support is quite the equal of the double over-arm in *rigidity* — an indispensable quality in any milling machine.

No other means of arbor support affords quite the same quick and easy access to the milling cutter — just a few simple motions and both cutter and arbor are free — an important convenience to the operator at all times.



Buy Victory

with at least 10% in War Bonds!

KEARNEY & TRECKER

CORPORATION

MILWAUKEE 14, WISCONSIN

[redacted] **MACHINE TOOLS**

Let's Put The Scrap Into The *Scrap!*

Turnings, clippings, short ends, worn out or broken tools — all these are valuable as precious scrap for remelting in the production of new steel. Surprising amounts of dormant scrap accumulate in every plant daily — collect it — segregate it. Set up a system for the regular pick-up and handling of this valuable raw material. Remember, it's a war on waste, too, and every bit of scrap *collected* counts in production for Victory.

18 CAM MILLING METHODS

. . . Described and Explained in this Kearney & Trecker Corporation Bulletin

Machining and milling cams of various types present special problems. This series of articles, reprinted from American Machinist in bulletin form, explains methods of cam milling from the practical shopman's viewpoint.

Many machine setups are illustrated, including working diagrams. Eighteen cam milling methods are described, such as use of the Rotary Table, Dividing Head, Dummy Templets, Rotary Head Milling Machine, etc.

Written by the department of Industrial Research, Kearney & Trecker Corporation, this bulletin will prove valuable to every shopman. Write Dept. CM for your copy.

Buy Victory with at least 10% in War Bonds!

Kearney & Trecker *Products* CORPORATION
MILWAUKEE, WISCONSIN
Subsidiary of Kearney & Trecker Corporation

Kearney & Trecker CORPORATION
Milwaukee, Wisconsin

CONSIDER

THE MACHINING OF A PART LIKE THIS!

SUPPOSE you had a contract to turn out thousands of the highly eccentric spool-like cams pictured here. Consider the work—the man-hours, the expense — of producing them unit by unit. What would your per unit cost soar to? How many rejects would you have to expect? What about the time element? What would happen to your production schedule?

The manufacturer of this cam eliminated those questions by *Turning to Turchan,* the all-hydraulic duplicator. A Turchan Follower, attached to a standard type lathe, proved to be the perfect answer to his problem. They are now produced about 20 times faster than was possible previously. You, too, can *Turn to Turchan* and save time, money and reject worries.

Turchan Followers attach easily to any standard type lathe, planer, shaper, grinder or mill. They do not interfere with normal use of the machine and what is just as important, they fit equipment you now have in your plant. You do not have to purchase new and expensive machine tools to use a Turchan Follower.

Turchan Followers, made for one, two or three dimensional work, are tops when it comes to die sinking or any other eccentric contour job. Write today for our new illustrated booklet.

TURN TO *Turchan*

FOLLOWER MACHINE CO.

Originators of Hydraulic Duplicating Attachments

8249 Livernois Avenue — Detroit 4, Michigan

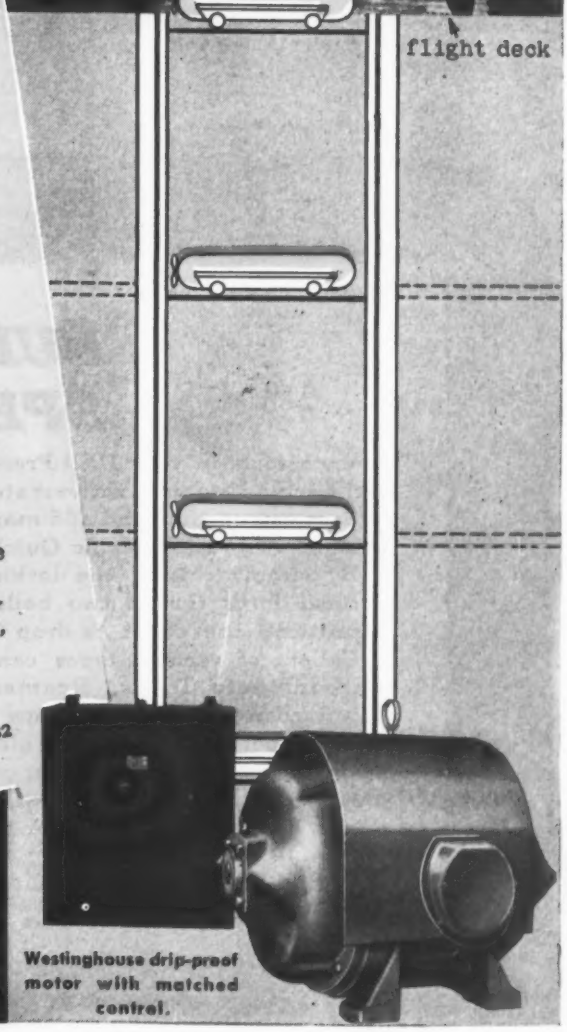
Delivering "FRESH FISH" . . gently . . for Axis breakfasts

"On the alert"—men, machines, and torpedoes function smoothly as one team on board this aircraft carrier. From the depths of the ship a fast-moving elevator lifts a load of deadly "tin fish", bringing its platform to a smooth stop within 1/16-inch of the deck. An important 1/16-inch, because it permits torpedoes to roll directly onto the flight deck without dangerous jarring—or extra, time-consuming handling.

The motor and control which power the elevator work as a team—lifting torpedoes at high speed to the deck and then slowing down gently to a stop "on the nose". To do this, the motor was built with two windings: a high-speed winding for lifting or lowering, and a slow-speed winding for leveling to an accurate stop.

Westinghouse builds many ratings of motors and controls for military and war industry applications. A multitude of these units, like the Westinghouse motor and controls in this elevator, are constructed to withstand the shock and pounding of sea and air battles. For any type of motor, any control . . . on any application . . . call your nearest Westinghouse office.

J-21282



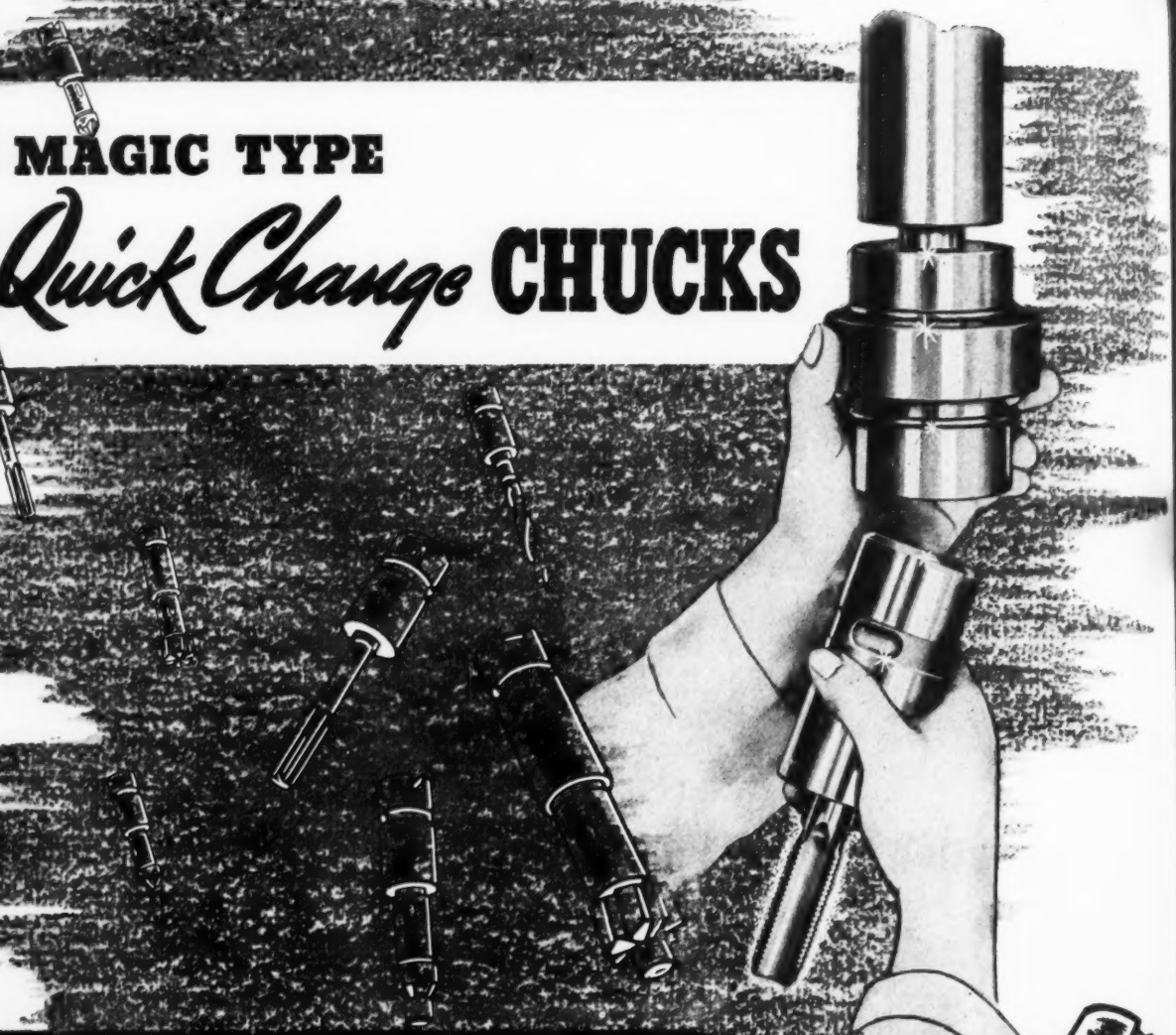
Westinghouse drip-proof motor with matched control.

Westinghouse

PLANTS IN 25 CITIES OFFICES EVERYWHERE

MOTORS AND CONTROL

MAGIC TYPE *Quick Change* CHUCKS



BUILT FOR SPEED . . .

Change tools in your Drill Presses, Turret Lathes, and Boring Machines without stopping the spindles ...Save set-up time and add many stations to your machines by using Magic Quick Change Chucks.

By simply raising the locking ring, the centrifugal force throws two balls out of position, permitting the collet to drop out automatically.

Collets of various types can be furnished to accommodate Drills, Reamers, Boring Bars, Counterbores, Core Drills, Taps and Special Tools.

Our Tool Engineers will gladly assist you in adapting Magic Quick Change Drives to your production problems. Send us sketches or blue prints for recommendations and quotations.

Scully-Jones
AND COMPANY
1901 SOUTH ROCKWELL STREET • CHICAGO, U. S. A.

The Shape of Things to Come . . .
at Consolidated Vultee Aircraft

One of a battery of Kane & Roach No. 1 Vertical-Type Angle Benders at the Consolidated Vultee plants, bending heavy extruded and formed shapes to the exacting contours required by the aircraft industry.

Formed on

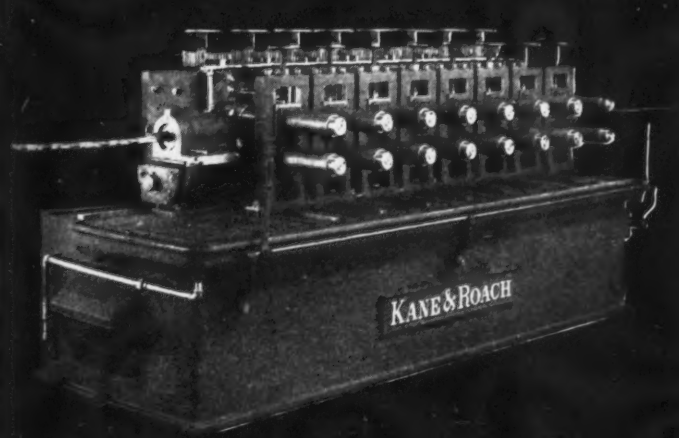
KANE & ROACH
BENDING ROLLS

Fast bending of bars, tubes, formed and extruded sections to precision dimensions—all with a minimum of labor and down-time for service. And all saving precious hours in fairing the surfaces and structural members of giant B-24 Bombers.

That's how Kane & Roach Bending Rolls are helping Consolidated Vultee Aircraft Corporation turn out the Liberator B-24's that are making daylight raids on Europe. And that's how Kane & Roach metal forming machinery (both hot and cold roll) will help turn out the planes that will bomb Tokyo and other Japanese cities by day and night. Famous in heavy industry for 56 years, Kane & Roach bending and forming machines are important production tools in big aircraft and munitions factories all over America.

KANE & ROACH, INC.
Syracuse, New York

A Few of the Shapes that Can Be Formed and Bent on Kane & Roach Forming and Bending Rolls



Yesterday—*Only true pioneers and thrill seekers would ride in the rickety "egg crate" plane. Yet that plane, with all its crudities, was a giant step in human progress and transportation. Without early abrading, processes such as grinding, it would have been impossible.*

Today—The giant air liner is a tremendous improvement on the plane of yesterday—as is the modern fighter or bomber over the planes of World War I. HONING—the advanced abrading process—helped to make this improvement possible. Safety, lightness, long operation without overhaul—all are dependent to some degree on HONING.

Tomorrow—We do not know what course the progress of air transport will take. But whatever it is, there will be greater need for better controlled machining processes.

Micromatic has developed the HONE ABRADING process to be ready for these advanced requirements. At present, HONING application is limited to serious war needs. Tomorrow, it can expand with many new applications already developed.

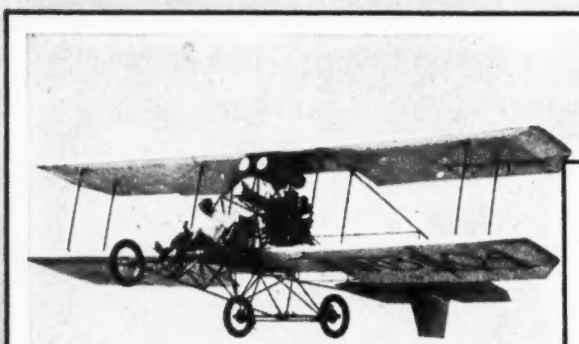
HONING

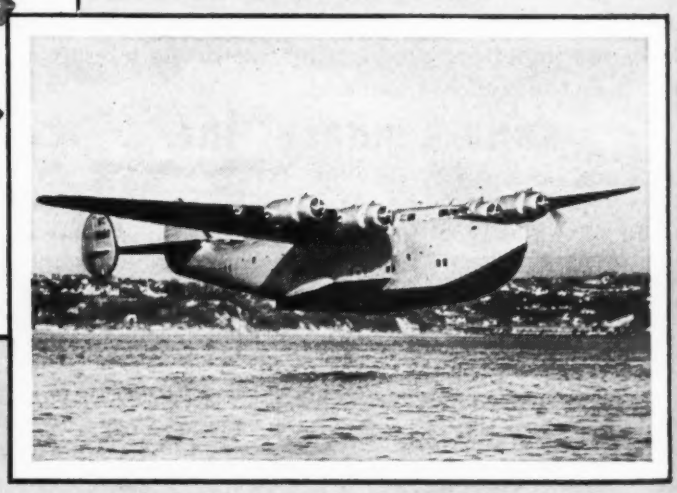
helped to develop yesterday's

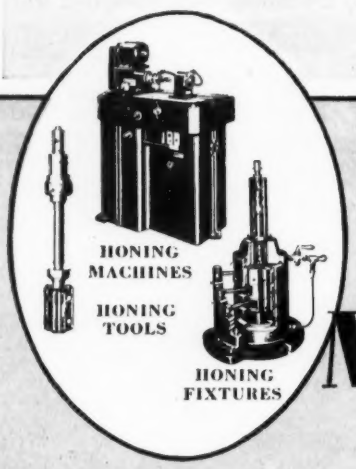
"EGG CRATE" Plane

into the

SAFE, MODERN AIR TRANSPORT







Micromatic HONE CORPORATION

Detroit, Michigan

MAKERS OF HONING MACHINE TOOLS

HONING helped create "400" Aviation

The tactical need for outflying our enemy has crowded military aviation into the "400" bracket, as may be seen in the comparison below:

	WORLD WAR I	WORLD WAR II
Speed	130 MPH	400 MPH
Period Between Engine Overhauls	40 Hours	400 Hours
Tactical Ceiling	12,000 Feet	40,000 Feet
Engine HP	125 HP (Liberty)	2,000 HP

This amazing advancement has been accomplished largely by better engineering design, better metallurgy and better controlled machining. Microhoning provides one of the most important machining controls by assuring maximum quality and safety in the bearing surfaces of our military and naval plane engines and other plane mechanisms.

Bearing bores and other critical surfaces are finished by Microhoning—the modern abrading process which removes stock at rates up to 65 cubic inches per hour, generates accuracy for roundness and straightness of bore within .0002" to .0003" and any desired surface finish.

Better planes for war mean better planes for the peace to come.

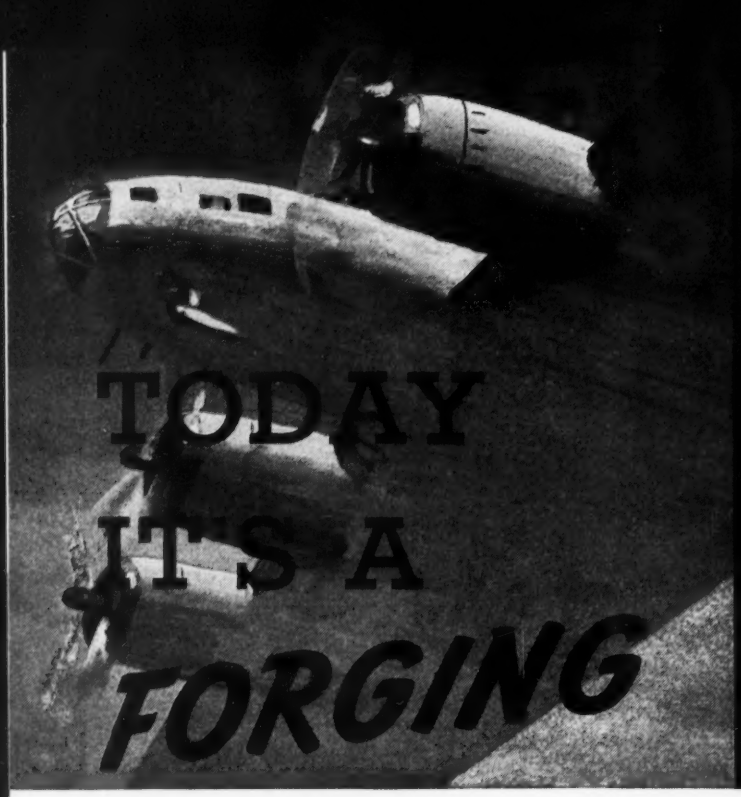
Some Microhoned Aircraft Bores

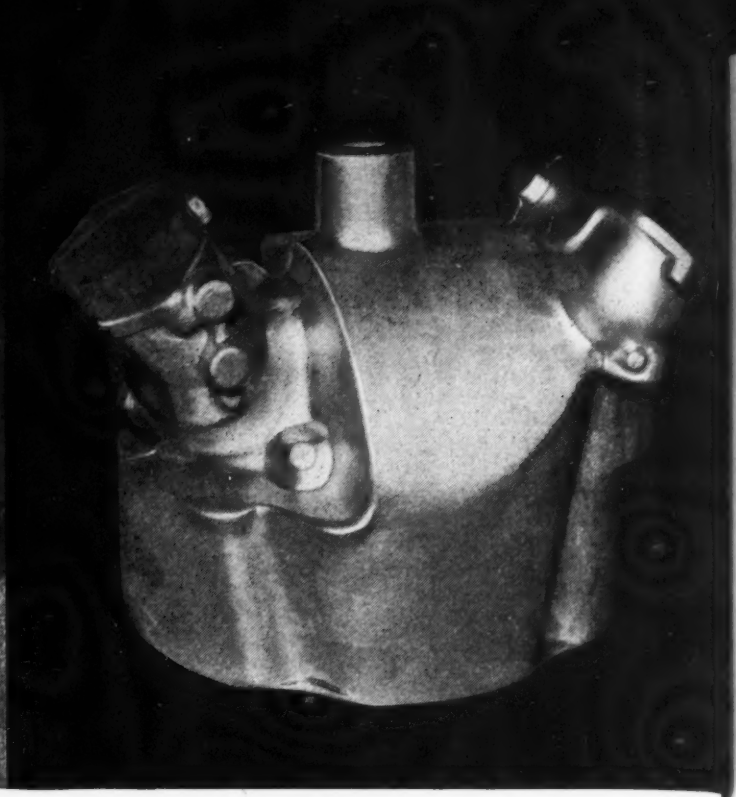
Engine Cylinder Barrels
Master Con Rod (all bores)
Articulated Rod (all bores)
Piston Pin Bores
Valve Guide Bores
Pinion Gear Bores
Oleo Cylinder Bores
Brake Cylinder Bores
Gun Turret Hydraulic Cylinder Bores and many other parts

MICRO MATIC

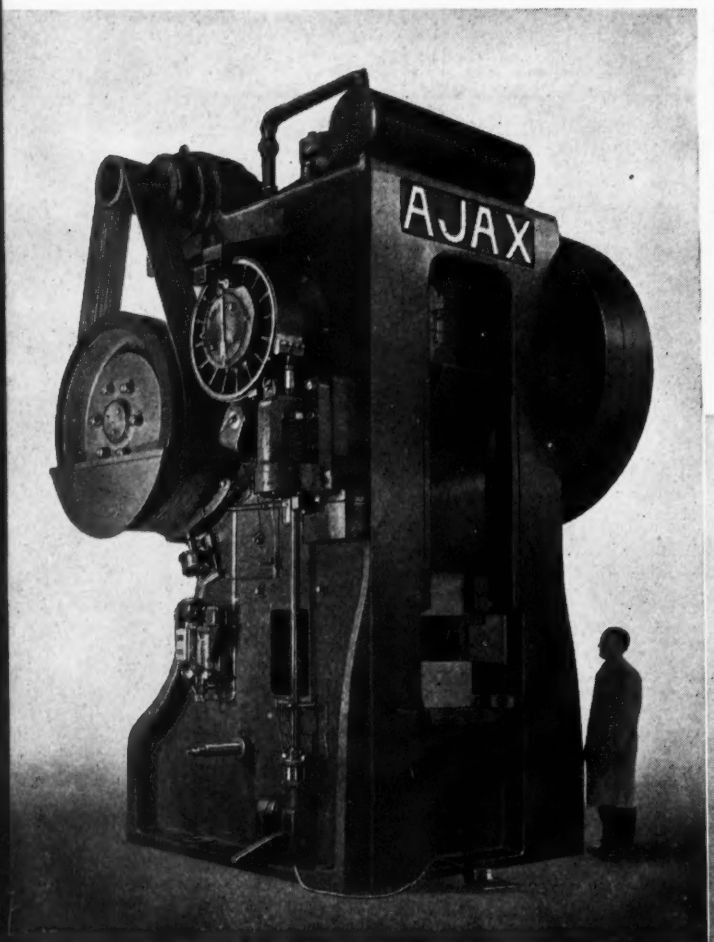
MICROMATIC HONE CORPORATION

DETROIT, MICHIGAN





This Aluminum Alloy Airplane Cylinder Head

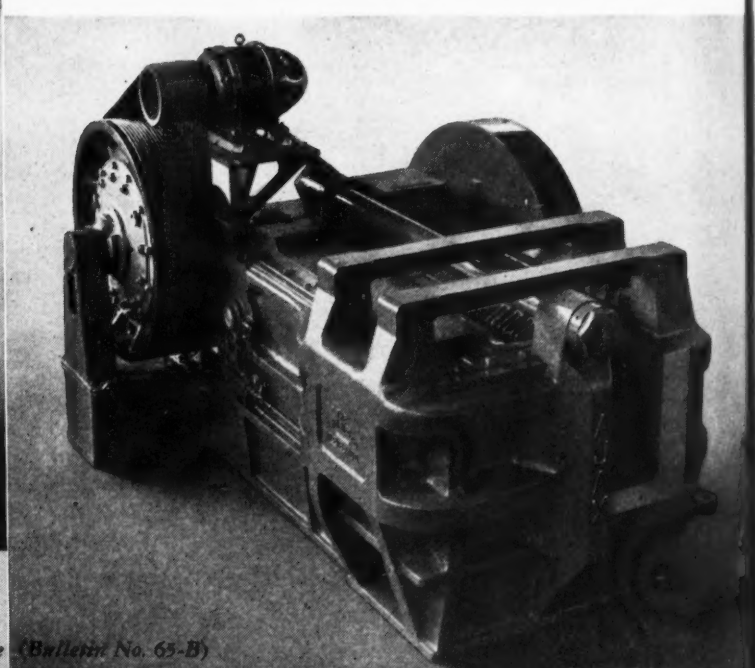


2500 ton Ajax High Speed Forging Press (Bulletin No. 75-S)

Again the Forging has come to the forefront with greater reliability and higher physical properties, resulting in phenomenal airplane engine improvement — increasing horsepower output 12% to 15% — decreasing fuel consumption — improving altitude performance.

Again Ajax Engineers, with their background of experience and pioneering vision, contributed to the development and perfection of this vital forging and its efficient production.

Again Ajax Machines — huge Forging Presses and Upsetting Forging Machines — in combination manufacture these forgings in quantities at high speed, eliminating unnecessary operations, saving man-hours, conserving material and with almost negligible loss from defects.



8" Ajax Forging Machine (Bulletin No. 65-B)

THE AJAX MANUFACTURING COMPANY

EUCLID BRANCH P. O. CLEVELAND, OHIO

621 MARQUETTE BUILDING · CHICAGO, ILLINOIS

Citation of Honor

ON THE PRODUCTION FRONT

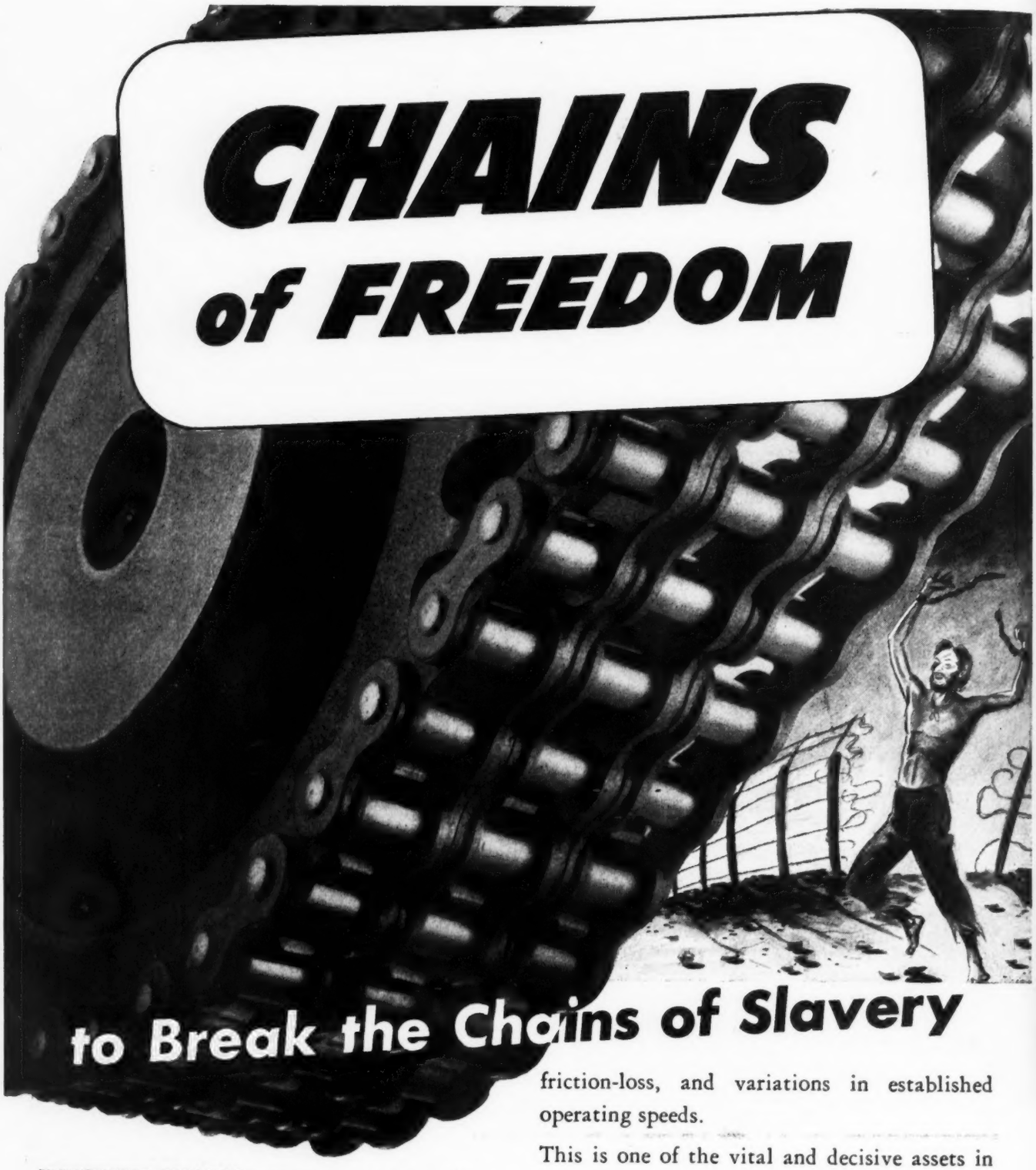
The men and women of the Quality Tool & Die Company, of Indianapolis, have received the coveted Army-Navy "E" Award in recognition of outstanding accomplishments in the production of precision inspection gages.

We are indeed proud of this, the highest honor which can be paid to civilians for their contribution to Victory. The "E" pins, which we wear, will serve as an inspiration to even greater achievements in the days ahead.

I wish to take this opportunity to publicly express my deep appreciation to all the loyal workers whose devotion to duty and constant striving for improvement has brought this award to the Quality Tool & Die Company.

Ray H. Rice.
General Manager

Quality
TOOL & DIE CO.
Manufacturers of "Quality Products"
INDIANAPOLIS, INDIANA



WHITNEY CHAINS transmit a constant flow of power to war-production machines . . . enabling them to pack every working minute of every shift with top-capacity output . . . by keeping power drives free from slippage, friction-loss, and variations in established operating speeds.

This is one of the vital and decisive assets in U. S. versus Axis war production . . . a fuller use, on our part, of time and energy which is bringing constantly closer the time of liberation for all the conquered nations.

THE WHITNEY CHAIN & MANUFACTURING COMPANY, HARTFORD, CONN.

DRIVE FOR VICTORY with

WHITNEY CHAINS

50 YEARS OF ENGINEERING SPECIALIZATION

. . . BUILT INTO BAUSH PRECISION MACHINES *for such a time as this!*

PHOTO shows a Baush Precision Tapping Machine tapping coolant plug holes in cylinder jacket of well known make of Aircraft Engine.

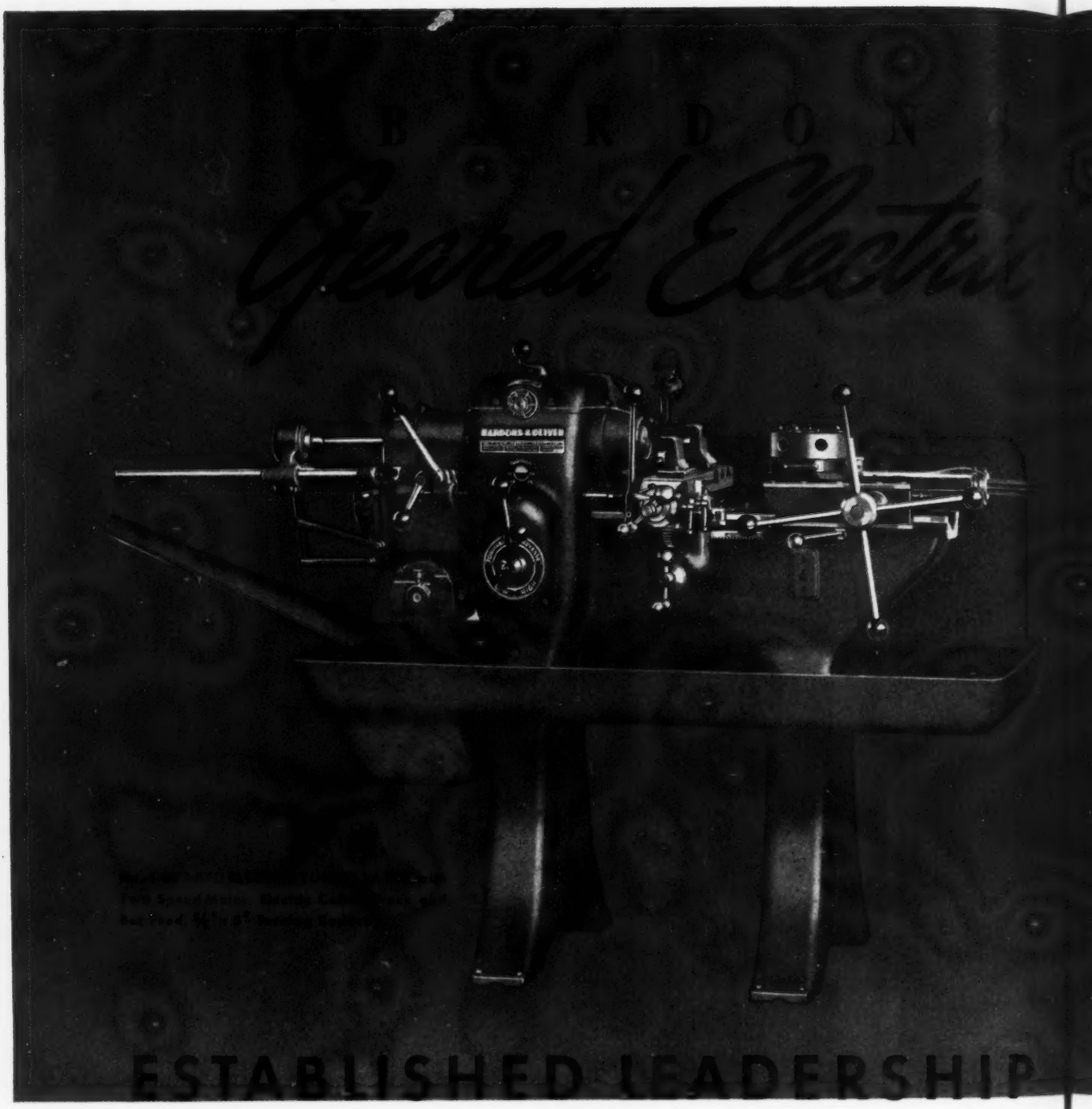
Half a century ago, Baush pioneered in the design and manufacture of high-production machinery for Drilling, Boring, Tapping, Reaming and kindred operations. Such machines, attuned to the needs of each succeeding decade, helped produce materiel for the Spanish-American War and for World War I. In today's struggle—when speed of production is surely a major factor in deciding the Victory—the foresight of Baush is bearing fruit, as never before in stepped-up output of almost every type of fighting equipment.

In most of the large Aircraft Engine plants across the nation you will find Baush Machines at work, as in the mid-western plant where this photograph was taken showing a Baush Precision Tapping machine in action tapping coolant plug holes in a cylinder jacket. The radial arm enables the tap to be quickly positioned over the various holes in the cylinder jacket, six such holes being tapped in one side of the casting without any readjustment of the work, and the same procedure repeated on the opposite side. Extra heavy base, sturdy column, conveniently placed controls are some of the more apparent features of this Tapping Machine. Unseen—but not less important to the successful performance of this Baush Machine—is the half-century of constant engineering experiment and improvement built into it, a factor that enables it to produce with the speed and sustained precision that the times call for.

ARMY ★ NAVY

BAUSH MACHINE TOOL CO.

SPRINGFIELD, MASS.



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IN THE SMALL TURRET LATHE FIELD

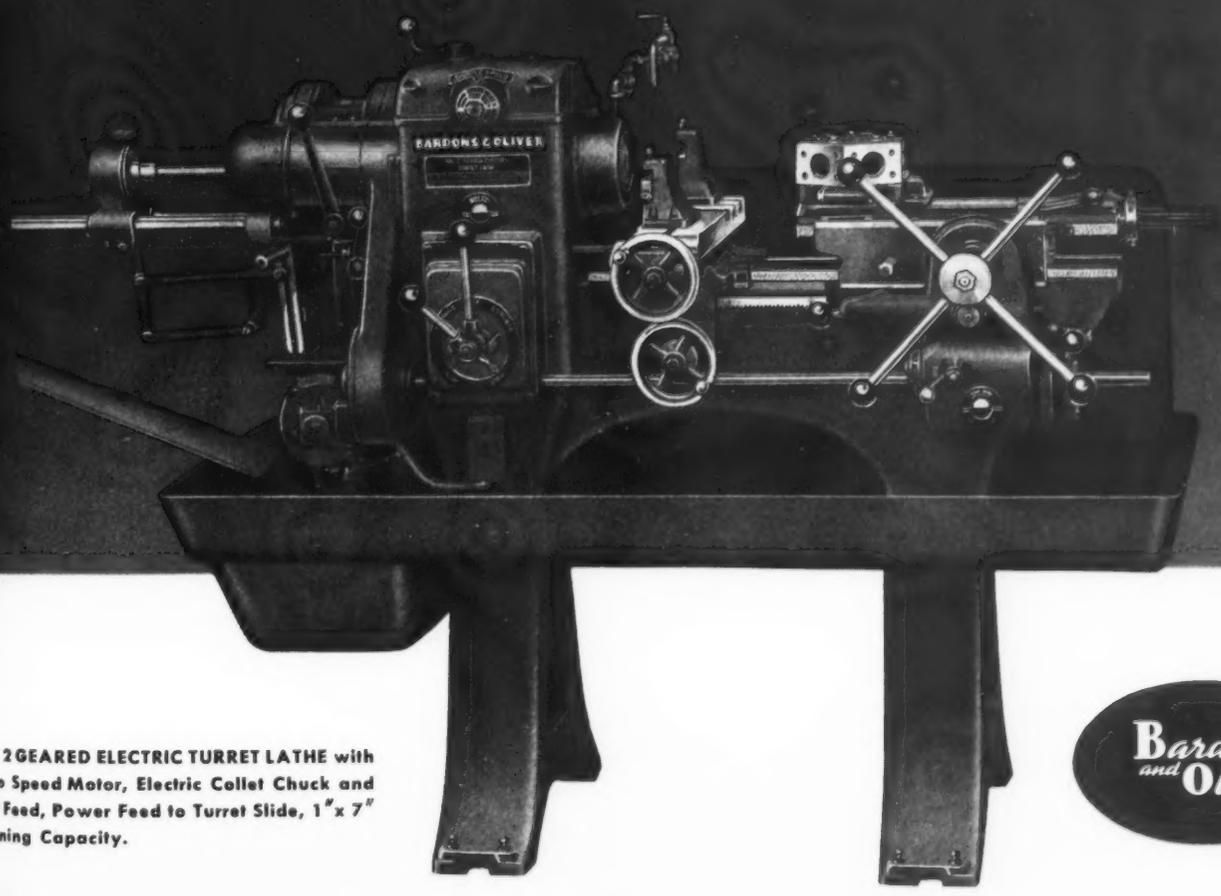
1. High Spindle Speeds (up to 3500 R. P. M.)
2. Six Speed Changes through Sliding Gears with Single Lever Control and Direct Reading Dial. (Twelve Speed Changes with Two Speed Motor)
3. 20 to 1 Speed Range without the Use of Pickoff Gears
4. Optional Speed Ranges to Suit Individual Requirements

BARDONS & OLIVER, IN

Turret Lathes

5. Instantaneous Electrical Spindle Reverse
6. Electric Power Operated Bar Feed and Collet Chuck (Optional)
7. Powerful Automatic Turret Clamp with Automatic Wear Compensator
8. Rigidity and Strength without Excess Weight

ALSO—BARDONS & OLIVER QUALITY AND SERVICE



No. 2 GEARED ELECTRIC TURRET LATHE with Two Speed Motor, Electric Collet Chuck and Bar Feed, Power Feed to Turret Slide, 1" x 7" Turning Capacity.

Bardons and Oliver

1133 W. 9th STREET CLEVELAND, OHIO

Look at these typical jobs handled better on the

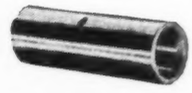
SUNNEN PRECISION HONING MACHINE!

Hydraulic Metering Valve Stem. Hole .156" in diameter; reamed, heat treated, and then honed. Honing 3 times as fast as previous method.

Aircraft Instrument Panel Control Wire Bushing. Hole .187" diameter — held to .0002", stock removal .001", sixty per hour.

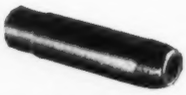
Header Die. Life of header dies increased 3 to 9 times over lapping. Knock out pin breakage practically eliminated.

Aircraft Hydraulic Brake Cylinder. Honing 3 times faster than lapping—and gave a straighter hole.



Aircraft Piston Pin. Sunnen honing is twice as fast and gives a cleaner, better looking pin.

Production Increased — Time Saved!

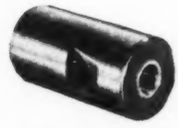


Cast Iron Valve Stem Guide. 1/2 to one thousandth removed —220 pieces per hour. Better finish and straighter hole.

Stainless Steel Load Compensator Valve Seat. Hole is honed to .0002" limit.

Aircraft Valve Tappet Roller. Honed after grinding to give 100% bearing surface.

Idle Valve Guide. Honing after grinding holds a .0002" limit necessary for accurate idling.



Shell Loading Die.

Closer Tolerances — More Accurate Work

Hydraulic Control Bushing. Honing gives straight round hole after rough reaming.

Aircraft Carbureter Operating Valve Sleeve. Sunnen honing eliminates distortion from assembling operation.

Automobile Distributor Shaft Gears. Taper removed at a rate of 80-90 per hour.

Compressor Yoke. Alignment maintained and better finish produced.

Mild Steel Clevis. Honing corrected errors of previous operations and maintained true alignment of two holes.

Errors Corrected — Alignment Maintained

Carbureter Idler Valve Jet. Hole is honed after reaming for smooth action.

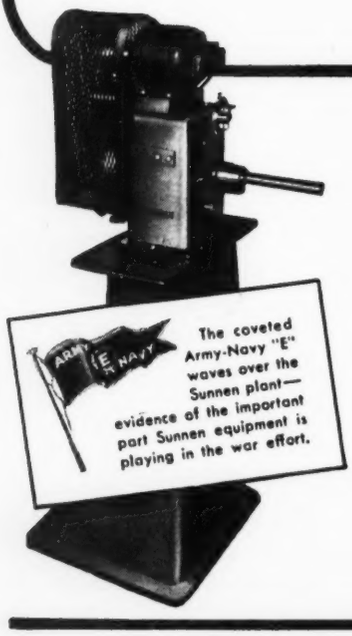
Roller Bearing Outer Race. Finish improved from 12 micro inches to 2 micro inches.

Bearing. A very small part 2 micro inch finish necessary.

Carbureter Idler Pump. Smooth, straight-line finish in blind hole prevents piston leakage.

Ceramic Insulator. Honing used to eliminate roughness inside ceramic tube.

Super-Smooth Finish!


ARMY
NAVY
The coveted Army-Navy "E" waves over the Sunnen plant—evidence of the important part Sunnen equipment is playing in the war effort.

The basic price of the Sunnen Precision Honing Machine is only $195! And operating costs are low.

No jigs or fixtures needed — work can be held in the hands. Relieves big internal grinder for other jobs.

Wide range — handles any internal diameter from .185" to 2.625".

Protect your investment in time, labor, and materials in your previous operations by using the Sunnen method for the LAST operation.

Does Not Require Skilled Labor!

Here's good news — girls in 'teens can be trained to handle jobs in "tenths" in a few hours.

Sunnen guaranteed accuracy assures fewer rejects and absolute interchangeability of parts.

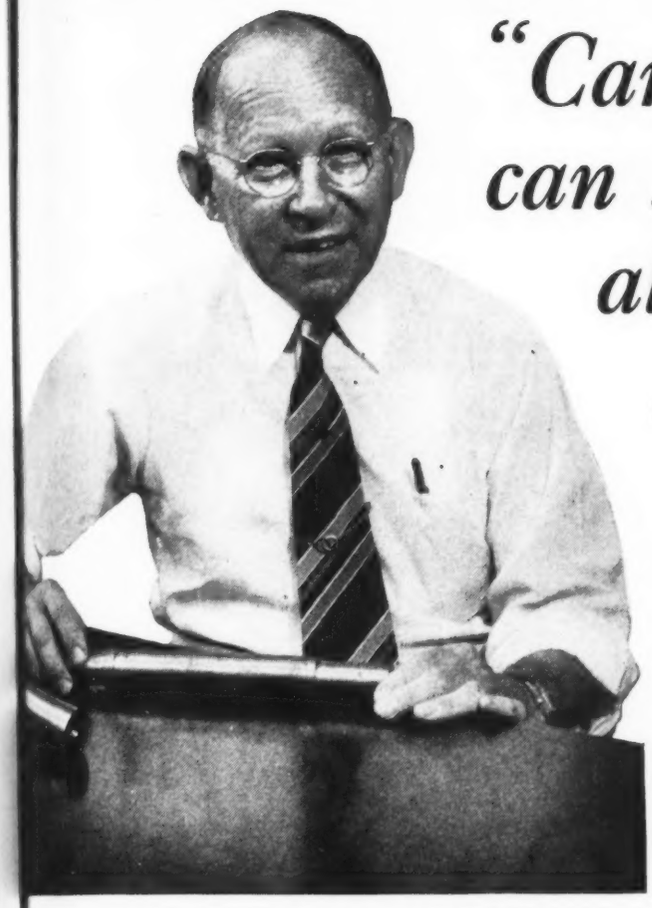
One of our sales engineers will be glad to help you solve your honing problems. Or, if you prefer—write for free bulletin giving complete information.

SUNNEN PRODUCTS COMPANY, 7940 Manchester Ave., St. Louis, Missouri

Canadian Factory, Chatham, Ontario

SUNNEN

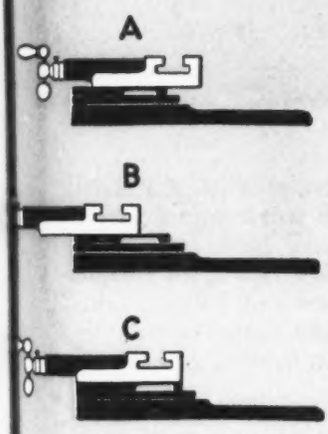
CUTTING TOOL TIPS FROM THE TOP-NOTCHERS—#6



"Care in rough cutting can save valuable time all along the line."

Says FRANK C. LANG, Superintendent
THE R. K. LeBLOND MACHINE TOOL CO.
Cincinnati, Ohio

• Many new lathe hands, even some old-timers, consider rough turning a kind of hacking process that doesn't call for much brain work or care. While roughing isn't directly as important as finishing, there are many places where an operator can avoid needless waste of material . . . save himself and others valuable minutes by remembering a few simple do's and don'ts.



"In rough cutting care should be taken to have the compound rest in the proper position. In both positions, Fig. 'A' and Fig. 'B,' a break could result in the middle of the tee slot. Fig. 'C' is correct. When making heavy cuts, top slide should be flush with bottom slide so all metal is in compression.

CHART FOR CEMENTED CARBIDE TOOLS

KIND OF MATERIAL	CUTTING SPEED Ft. per Min.	DEPTH OF CUT Inch	RATE OF FEED Per Rev.
CAST IRON	210	3/8	0.062
SEMI-STEEL	280	1/8	0.012
TOOL STEEL	140	1/2	0.020
BRONZE	425	3/16	0.024
BRASS	458	3/32	0.108
ALUMINUM ALLOY	570	1/8	0.031

"There is a tendency for many lathe operators to work their machine far below top efficiency because they fail to take a deep enough bite. Where tool failure is the limiting factor in size of roughing cut, it is usually possible to reduce the speed but increase the feed to such an extent that the amount of metal removed is greater than when operating at a faster clip. When using carbide type tools, the figures shown in above chart can be used for a general guide.

"In rough turning, hard-to-replace tools are often neglected because the operator thinks he can get by with a tool so dull that it actually is pushing the metal off instead of cutting it off. The best method for grinding tools is by the semi-automatic grinding machine. To cut free, a tool must be ground with four correct angles—side clearance, back rake, side rake, and end clearance. Refer to a tool manufacturer's manual."

Care in the selection of your cutting oil is as important as care in lathe operation. That's why Shell has developed a control technique that "balances" the oil to the machine, the application and the tool. Call in the Shell man now for details.

SHELL

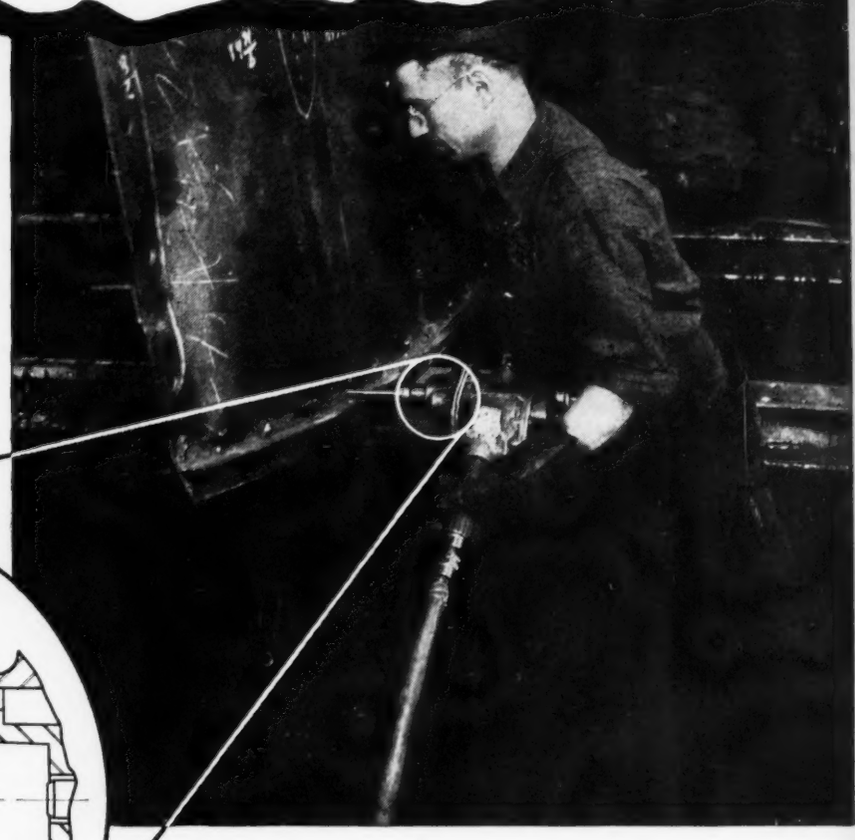
SHELL LATA OILS
FOR METAL WORKING

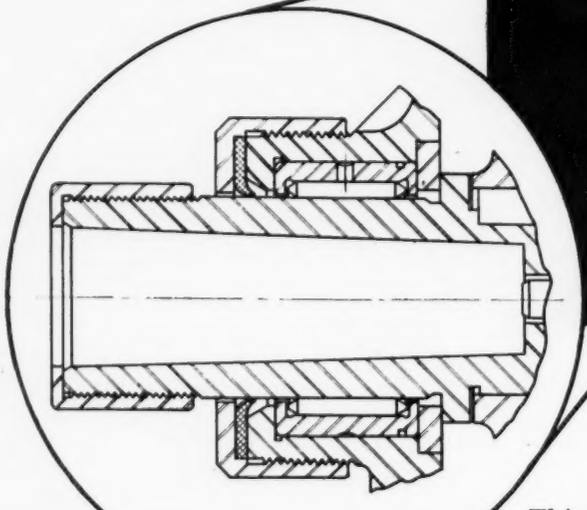
"...use of your roller bearing, acting on a large area of the work spindle, reduces the wear so that we have practically no replacements on them."

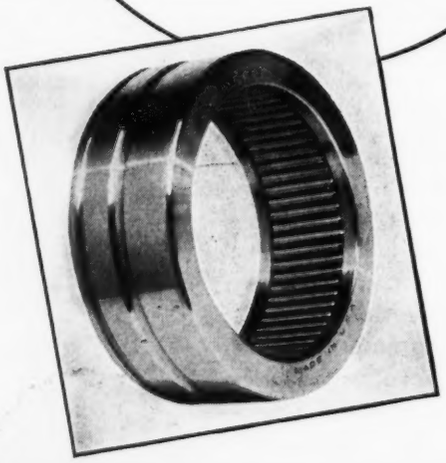
The Rotor Tool Co.

RBC

NEEDLE BEARINGS







WHILE the motor in this Rotor Tool Air Drill operates at high speeds, the work spindle traveling in an RBC CYCLOPS Needle Bearing runs at comparatively low speeds and develops high torque. This RBC Bearing, with a full complement of rollers, minimizes the wear on the work spindle that would ordinarily occur and require frequent replacement.

Then too, the basic construction of the RBC CYCLOPS provides for minimum overall dimensions and maximum carrying capacity—a contributing factor in this statement made by The Rotor Tool Co., "... the modern rotary type tools, such as we build, are so much lighter in weight than the older types of machines that frequently the job requires one man where it used to take two, and one operator can turn out 50% to 60% more work with the lighter tool."

Can you find here a clue to more efficient operation of the equipment *you* build? We'd be glad to have you consult with our engineering staff.

ROLLER BEARING CO. of AMERICA

TRENTON .... NEW JERSEY